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1817

Real Estate Department,

W. H. WILSON,
Consulting Engineer.

PENNSYLVANIA RAILROAD,

233 South Fourth Street,

Philadelphia, Jany 1st 1882

James Reed Esq
Prin Assist Engr
Dr Sir

I am much obliged for your attention in sending me a plan of the old frog found on the line of the Portage RR — It is a reminder of old times. It is similar to those that were used on the old Columbia R R — and very probably designed by the same person, Mr John Elgar. who was specially engaged to attend to the turnouts, frog switches &c on the Col. RR — and I think on the Allegheny Portage also —

I send you with this a pamphlet containing a history of the State Improvements which you may possibly not have seen — Yours truly

W H Wilson Ce

NOTES

ON THE

INTERNAL IMPROVEMENTS

OF

PENNSYLVANIA,

BY W. HASELL WILSON, C. E.

AND

REMINISCENCES

OF THE

FIRST RAILROAD OVER THE ALLEGHENY MOUNTAIN,

BY SOLOMON W. ROBERTS, C. E.

PHILADELPHIA:
RAILWAY WORLD, No. 423 WALNUT STREET.
1879.

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INTRODUCTORY NOTICE.

The growing interest in the early history of the public works of Pennsylvania ensured such an earnest appreciation of the valuable articles appended, while they were appearing in consecutive numbers of the Railway World, during 1878, that we have received numerous applications for their publication in pamphlet form.

In responding to their request, we have deemed it fitting to briefly record some of the leading features of the professional careers of Mr. Wilson and Mr. Roberts, for the purpose of showing their peculiar qualifications for the useful task they have so well performed.

Mr. W. Hasell Wilson, in addition to his prolonged service in connection with the railway system of Pennsylvania, is the descendant and progenitor of a race of distinguished civil engineers and architects.

His grandfather, Lieutenant John Wilson, who was the son of an architect at Stirling, Scotland, served in this country during the revolutionary war, as an officer of the 71st Highland Regiment, on engineering duty, and assisted Major Moncrief, of the Royal Engineers, at the sieges of Savannah and Charleston, South Carolina. Being severely wounded at the latter city, he continued to reside there some time after its capture, and at the termination of the war, married the daughter of a resident of Charleston, who was a native of Scotland. Lieutenant John Wilson subsequently returned to Stirling, where Major John Wilson was born, March 9th, 1789, and where he received the early portion of his education. It was supplemented by studies at the University of Edinburg, where he became specially proficient in mathematics, drawing, and other branches appertaining to engineering. In 1807, after the death of Lieutenant John Wilson, his widow and her four children returned to Charleston, South Carolina (her native place), and her son, John Wilson, soon entered into business there as an engineer and surveyor. When the second war with Great Britain broke out he volunteered his services, as engineer, to his adopted country; and it is a singular coincidence that, in planning and supervising the construction of works for the defence of Charleston, he used the same drawing instruments, now in the possession of W. Hasell Wilson, that had been employed by his father when he was preparing plans for the attack upon that city made by British forces during the Revolutionary struggle.

Subsequently he was appointed Major in the United States Corps of Topographical Engineers, and in 1818, when the office of civil and military engineer of the Board of Public Works of South Carolina was created, he became the first incumbent of that position, which he continued to hold until 1822. In 1826 he removed to Philadelphia, where internal improvements then attracted much attention; and, in the spring of 1827, he was entrusted by the Board of Canal Commissioners of Pennsylvania with the important duty of examining a route for a canal between the Schuylkill and Susquehanna rivers, through Chester and Lancaster counties, with instructions to report upon the expediency of a railroad if he found the construction of a canal impracticable. For various reasons, he came to the wise conclusion to report against the canal and for a railroad. This action led to the construction of the Philadelphia and Columbia Railroad, in the location and construction of which important improvement Major John Wilson was actively engaged as Chief Engineer from 1828 until the winter of 1832, when his health became seriously impaired. During this period, with the consent of the canal commissioners of Pennsylvania, he located the line of the Camden and Amboy Railroad. He died February 27, 1833, in the harbor of Matanzas, where he had gone to strengthen his shattered constitution.

Mr. W. Hasell Wilson, son of Major John Wilson, was born at Charleston, South Carolina, in 1811, and, in 1828, he formed one of the party engaged, under the direction of his father, in locating the Philadelphia and Columbia Railroad. In 1829, when construction commenced, he was placed in charge of one of the sub-divisions as assistant engineer. In 1831 he was appointed principal assistant engineer on the eastern forty miles of the road, which position he continued to hold until the completion of the line in 1834. During the next five years he was successively engaged in conducting surveys for a proposed line of railroad from Reading to Downingtown; in the service of the Philadelphia and Reading Railroad Company, twenty miles of whose road, between Norristown and Reading, were finally located and constructed under his direction; and in acting as Chief Engineer on the Gettysburg Extension.

The interval, from 1839 to 1852, was devoted to agricultural pursuits, but, in the latter year, he resumed his profession, and, after being engaged in surveying a proposed new line between Philadelphia and Harrisburg, and in various other railway enterprises, in January, 1856, he entered the service of the Pennsylvania Railroad Company. After it purchased the Philadelphia and Columbia Railroad, in July, 1857, Mr. Wilson was appointed Resident Engineer of that line. In January, 1858, his division was extended to Mifflin, fifty miles west of Harrisburg, and in January, 1859, he was appointed Resident Engineer of the entire line of the Pennsylvania Railroad, from Philadelphia to Pittsburgh, with its branches.

In 1862 his title was changed from Resident to Chief Engineer. The constantly increasing duties of the maintenance of way, together with the large amount of new work devolving upon the engineer department, had, by the close of the year 1867, accumulated to such an extent as to render a division of labor necessary. A department of construction was accordingly organized, to take charge of all new work, which went into operation in January, 1868, and of which W. H. Wilson was made chief engineer, to report directly to the President of the company, with headquarters at Philadelphia. The maintenance of way constituted a separate department under the General Superintendent of the road, with headquarters at Altoona, and John A. Wilson, son of the former, who had been for several years chief engineer of the Philadelphia and Erie Railroad, was appointed chief engineer of maintenance of way.

During the succeeding six years a very large amount of new work was constructed, to provide increased facilities for the growing business of the company, embracing passenger and freight depots, water and coaling stations, additional tracks, an extensive set of new car shops at Altoona, piers and shutes for transferring coal at the Delaware river, and the straightening of several miles of road on the eastern portion of the Philadelphia division. At the same time the Construction Department had charge of a considerable amount of new work on the Philadelphia and Erie Railroad, and the Lewisburg, Centre, and Spruce Creek Railroad.

The financial panic in the latter part of the year 1873, caused a suspension of all new work, with the exception of finishing up that which was near completion, and at the end of the year the Construction Department was discontinued.

In November, 1873, W. H. Wilson was elected President of the Philadelphia and Erie Railroad Company, but was continued in the service of the Pennsylvania Railroad Company as consulting engineer, with the special duty of closing up the work previously under his charge, and completing the maps and engineering records of the road.

In July, 1874, he resigned the presidency of the Philadelphia and Erie Railroad, and was placed at the head of a new department of the Pennsylvania Railroad, entitled the Real Estate Department, which was entrusted with the charge of all the real estate on the lines of the Pensylvania Railroad, the Philadelphia and Erie Railroad, and the United New Jersey Railroads as far as regarded the completion and arrangement of maps and records, the supervision of deeds and leases, and the settlement of taxes, together with such other matters as pertained to making the department a complete bureau of the real estate of the company.

This position Mr. W. H. Wilson still holds.

Mr. Wilson's three sons, John A., Joseph M., and Henry W., now associated as the firm of Wilson Brothers & Co., Civil Engineers and Architec s, make the fifth generation in direct succession of the same profession.

Mr. Solomon W. Roberts was born in Philadelphia, August 3d, 1811, being the first child of Charles and Hannah (White) Roberts, both of whom were members of the Society of Friends. His paternal ancestors came from Wales, in the time of William Penn, and settled near Gwynedd, about eighteen miles north of Philadelphia, while his mother's father Solomon White, was a successful merchant in the same city.

When about sixteen years of age he left school and went to Mauch Chunk, Pennsylvania, where he entered the family of his uncle, Josiah White, the principal founder of the Lehigh Coal and Navigation Company, and acting manager and superintendent of their works. By him he was employed as an assistant. In the spring of 1827, under the direction of Josiah White and his partner, Erskine Hazard, the Mauch Chunk railroad was opened for use, and S. W. Roberts rode on the first train of cars sent over its line, which was the first train in Pennsylvania. The road was nine miles long from the anthracite coal mines at Summit Hill to the Lehigh river at Mauch Chunk.

In 1827 the construction of the Lehigh canal was actively begun, the chief engineer being Canvass White, and S. W. Roberts was a rodman in the corps.

He was soon promoted to be an assistant engineer, and he remained upon the line until the canal was completed. in the autumn of 1829, from Mauch Chunk to Easton, a distance of forty-six miles.

He then entered the service of the State of Pennsylvania, and removed to Blairsville, where he had charge of the construction of a division of the canal on the Conemaugh river between Blairsville and Lockport, including a large aqueduct of cut stone across the river at the latter place.

In the spring of 1831 the Portage Railroad over the Allegheny mountain was begun by the State. The chief engineer was Sylvester Welch, and his principal assistant was Solomon W. Roberts, who led the exploring party, though but twenty years of age, on the western half of the line. This division included a tunnel 901 feet long, which was the first railroad tunnel in America, and the great viaduct over the Conemaugh at the Horseshoe Bend, which was designed and superintended by him, and which is still used as a part of the Pennsylvania railroad, located many years afterwards.

After the completion of the Allegheny Portage Railroad, with a double track, ten inclined planes and twenty stationary engines, he remained as its resident engineer and superintendent of transportation, thus beginning his career as a railroad superintendent.

He resigned from this position in 1836, and went to Europe to superintend the manufacture of railroad iron for the Philadelphia and Reading and other railroads. He was absent nearly two years, passing a large part of his time in the iron region of South Wales. In the spring of 1837, George Crane, an iron master at Yniscedwin, near Neath, succeeded in smelting iron ore on a practical commercial scale, by the use of anthracite coal and the hot blast, and his claims as the inventor of the process were finally fully established by the result of legal proceedings in England. Solomon W. Roberts visited Mr. Crane's works, became his friend, and sent over the particulars of his process to Josiah White, in Philadelphia, and to the Franklin Institute. Soon after Mr. White and his associates established the Crane Iron Works, on the Lehigh, and the smelting of iron ore with anthracite coal has since become one of the most important interests in Pennsylvania.

From 1838 to 1841, S. W. Roberts was the chief engineer of the Catawissa Railroad. In 1842 he was the president of the Philadelphia, Germantown and Norristown Railroad Company, and also its superintendent. After that he was, for three years, to 1846, the president of the Schuylkill Navigation Company, and formed the general plan for the enlargement of the works, by which the tonnage of the boats has been more than doubled.

In 1846 the act to incorporate the Pennsylvania Railroad Company was passed, and in 1847 the charter was issued. S. W. Roberts took a lively interest in the organization of the company, and he was offered a prominent position in its service, which he declined; but, at the instance of the directors, he consented to become a candidate, and was elected one of the representatives of the city of Philadelphia, in the Legislature of the State. He served in that capacity in the session of 1848, and had charge of the railroad bills in which the city was interested. His long experience in railroad matters, and his facility in public speaking on topics connected with his professional pursuits, enabled him to be of good service; and legislation important to Philadelphia, the Commonwealth, and the Pennsylvania Railroad, was obtained at that time.

An act was also passed to incorporate a company to construct the "Ohio and Pennsylvania Railroad," from Pittsburgh to the Ohio State line. In 1848 Mr. Roberts became its chief engineer, and located the road not only to the State line, but beyond as far as Crestline, Ohio, the site of that town and Alliance being selected and named by him.

In 1849, by appointment of the Board of Trade, he represented the city of Philadelphia in the National Pacific Railroad convention, held at St. Louis.

He planned the railroad bridge across the Allegheny river at Pittsburgh, connecting the Western line with the Pennsylvania Railroad. As the different divisions of his road were opened for use, he became the general superintendent of the working of the line. It reached Crestline, Ohio, 188 miles from Pittsburgh, April 11, 1853. It intersects the Cleveland, Columbus and Cincinnati road at that point. It now forms the Eastern Division of the Pittsburgh, Fort Wayne and Chicago Railway, one of the most successful and valuable lines in the country. When S. W. Roberts became its chief engineer, the company, though organized, had not $500 in cash, and for some time he served without salary. He continued in charge of the road until 1856, when he resigned, and returned to Philadelphia to reside.

In that year he became the chief engineer and general superintendent of the North Pennsylvania Railroad, one track of which was then in use from Philadelphia to Gwynedd. Under his direction the work was continued, and the road opened to Freemansburg, on the Lehigh, January 1, 1857, and to Bethlehem, July 7, of the same year, where it connects with the Lehigh Valley and Lehigh and Susquehanna Railroads.

In 1875, S. W. Roberts was appointed, by the municipal authorities of Philadelphia, one of a board of five engineers, three of them from other cities, who made an elaborate examination and report upon the water supply of this city.

Having been the chief engineer and general superintendent of the North Pennsylvania Railroad for twenty-two years, and having reached the age of 67 years, he resigned as general superintendent in January, 1879, but continues to be the chief engineer of the company.

PUBLISHERS OF THE RAILWAY WORLD.

Philadelphia, February, 1879.

NOTES ON THE INTERNAL IMPROVEMENTS OF THE STATE OF PENNSYLVANIA.

By W. Hasell Wilson, C. E.

ONE of the earliest movements in America towards the construction of railroads, was the passage of an act by the Legislature of Pennsylvania, at the Session of 1822 and 1823, incorporating a company to construct a railroad from Philadelphia to Columbia, to be called the Pennsylvania Railroad, the width of which was not to exceed 40 feet, and the rise not to make an angle of more than two degrees with the horizon The construction was to be in accordance with the plans, and under the superintendence, of Col. John Stevens. No further action appears to have been taken in regard to this project, but the movement indicated that public attention was being aroused towards the necessity for some better mode of transportation than then existed.

In the year 1826 the Stevens charter was repealed, and an act passed to incorporate another company to build a road between the same points, but this shared the same fate as its predecessor.

On the 27th of March, 1824, the Legislature passed an act "providing for the appointment of a board of commissioners for the purpose of promoting the internal improvement of the State." Within four days after, the Governor appointed Jacob Holgate, James Clarke, and Charles Treziyulney, who assembled and organized as a board at Lebanon on April 16th, when they adopted a resolution "to employ an engineer of known talents, skill, and experience in canaling, if such an one could be found, and submit to him the organization of such other aid or assistance as he should find necessary."

On May 10th the Board met at Philadelphia, and the President reported "that he had made the most diligent search and anxious inquiry after an engineer who was experienced in constructing canals, and that all his efforts to procure such an one had been unavailing." An attempt was then made to obtain the services of an engineer from the United States corps, but, after some time spent in correspondence, this also failed, and the board, being left to their own resources, employed surveyors to run levels, and took hold of the work themselves, displaying great energy and perseverance.

After mentioning the fact of having purchased a spirit-level and ordered four more, the board in their report proceed as follows: "When the Commonwealth has the proper instruments, young men will be found who will very soon learn to use them with accuracy and dispatch, and in this way the fruitless efforts to get assistance from abroad will be superseded by the culture and encouragement of genius at home." "We have found by observation and experience, that, purchasing the proper instruments, and encouraging active men who have some general acquaintance with science to use them, is the most effectual method for the State to get a proper corps of civil engineers, and to have the most and best work done in the shortest time and at the least expenses." It is hard to realize at this day that such difficulties in procuring engineers existed at so recent a period; and when we take into view the immense extent of our present railroad and canal system, we can scarcely believe it to be the growth of but fifty years. Nor should we be surprised that mistakes were made, but rather wonder that so few important errors were committed, when we consider the manner in which engineers were manufactured.

By the act for their appointment the board of commissioners were instructed to explore routes for canals:—1st. From Harrisburg to Pittsburgh by the Juniata and Conemaugh rivers; 2d. Between the same points by the west branch of the Susquenanna river, the Sinnemahoning creek, and the Allegheny river; 3d. Through the country between the Schuylkill and Susquehanna rivers, by the great valley of Chester and Lancaster counties; and 4th. From the Schuylkill river, in Schuylkill county, by Mahanoy creek, Susquenanna river, Moshannon or Clearfield creek, Blacklick creek, and Conemaugh, Kiskiminetas, and Allegheny rivers.

The following epitome of the report of the board of commissioners, presented to the Legislature in February, 1825, will give a general idea of what was done by them during the previous year:—

Succeeding their remarks in regard to the difficulty of procuring engineers, the report continues: "The duties enjoined on us by law evidently required three separate and distinct processes. First. A reconnaissance or ride over the country intended to be examined. Second. Running experimental lines or taking running levels. Third and last. The actual location of the canal." The third of these processes was, for obvious reasons, not attempted; but the other two were performed in a manner worthy of praise, when we consider that the commissioners were not engineers, and that they were called upon at very short notice, to devote their whole time and attention for some ten months, to the examination and consideration of important subjects of a character entirely new to them, involving considerable physical as well as mental exertion.

It appears that they commenced operations with the survey between the Schuylkill and Susquehanna rivers, by the great valley of Chester and Lancaster counties, one of the members of the Board giving the work his personal supervision, while the other two were engaged in reconnoitering.

In the month of September two of the commissioners met at Pittsburgh the United States Board of Internal Improvement, consisting of Gen. Bernard, Col. Totten, and John L. Sullivan, Esq., with whom they made examination of the route by the Allegheny, Kiskiminetas and Conemaugh rivers to the Allegheny mountain, and thence by the Juniata and Susquehanna rivers to Middletown, whence they continued *via* Lancaster to Philadelphia.

Before the season closed, surveys were made from the Allegheny mountain, along the Juniata and Susquehanna rivers to Harrisburg, and over the mountain between the head waters of the Juniata and Conemaugh rivers.

The report of the commissioners was very elaborate, going very much into detail, and furnishing a large amount of information upon which to predicate future operations; but their attention was exclusively directed towards a continuous canal, their zeal for which appeared to increase with the progress of their examinations, as will be seen by the following extracts from their report, some of which are rather amusing:—

"That our views may be more distinctly understood, we avow it as our decided opinion that there should be a leading uninterrupted canal, made and owned by the Commonwealth, the whole length of the State, so that a boat loaded at Pittsburgh can land her cargo at Philadelphia."

After describing the proposed tunnel through the Allegheny mountain, which was to be four miles in length, and 754 feet below the summit, the report proceeds: "The project of tunneling some three or four miles through a mountain, is to the uninformed a fertile source of amusement, from which they can extract the value of their taxes in good-humored laughter, and to the envious and secret or avowed enemy of public improvement it cannot fail to be a subject of malignant and bitter sarcasm. Even good men who love to see the improvement of their country, have been startled at the idea of burrowing in the ground for a few miles to let large boats pass through the bowels of the Allegheny; to such it will be a consolation to know that tunnels are now become and becoming very common. An engineer of the first standing in this country has said, that tunnels are now so common that the necessity of them is no greater obstacle than the increase of expense. And the United States engineers, in a letter to this board of the 4th of October last, say that the art of canaling and perforating mountains with tunnels is in modern times, in European states, a practice of too frequent occurrence to be deemed an obstacle, where the object of the work warrants the expense."

"A tunnel is a passage like a large well, dug horizontally through a hill or mountain, where there is not water enough to lock over it, or where the lockage-over would be too expensive. They are protected by arches, unless where the solidity of the rock above renders arching unnecessary. Although they are more expensive and tedious in the execution than any other works in canaling, yet they are less liable to decay or injury; having no perishable materials, neither summer nor winter, cold nor heat, affects them."

It should be observed, that Mr. Treziyulney being prevented by sickness from joining in the report made by the other two members of the board, subsequently submitted a separate report signed by himself alone, in which he differed from his colleagues in regard to the Allegheny tunnel, which he characterized "as an experiment full of doubts, difficulties, and perplexities; wholly inexpedient to venture on even if practicable."

On the 11th of April, 1825, an act was passed repealing the one of the previous year, and providing for the appointment of five canal commissioners "to consider and adopt such measures as they shall think requisite and proper, preparatory to the establishment of a navigable communication between the eastern and western waters of the State and Lake Erie." The routes designated for examination were: 1st. From Philadelphia to Pittsburgh, and thence to Lake Erie; 2d. From Philadelphia to the northern boundary of the State, in the direction of Seneca or Cayuga lake; 3d. Through Cumberland and Franklin counties to the Potomac river; 4th. Through Bedford, to connect the Juniata route with the proposed Chesapeake and Ohio Canal.

The commissioners were empowered to employ engineers, and required to make surveys, prepare estimates, and make full report at the next session of the legislature.

The report of the commissioners, dated February 3d, 1826, and signed by John Sargeant president, and Joseph McIlvaine secretary, states that during the previous summer the attention of the board was "directed exclusively to those routes which were supposed to admit of a navigable communication between the Allegheny and Susquehanna rivers, across the great ridge which divides the eastern and western waters of the State."

The examination of these routes were conducted by William Wilson, of Lycoming county, John Mitchell, of Centre county, Francis W. Rawle, of Philadelphia, and John Davies, of Dauphin county, whose reports, field notes, and drafts were placed in the hands of Mr. William Strickland, civil engineer, by whom a general map and profile were compiled, and an estimate of cost prepared.

The board was not favorably impressed with the tunnel plan, and appeared to consider the Juniata route, with a railroad portage over the Allegheny mountain, as presenting the best features, but as the act of assembly referred exclusively to the establishment of a navigable communication between the eastern and western waters, they concluded, that according to the strict limit of their duty, they would be compelled to recommend the northern route, because that alone fulfilled the conditions. In view, however, of the importance of the subject, they recommend, "that without delaying such legislative measures as might be necessary for commencing and prosecuting the work, the final decision between the routes, should be referred to a board of disinterested professional engineers, constituted in such manner as the legislature might think proper, and acting in conjunction with the commissioners."

"An act to provide for the commencement of a canal, to be constructed at the expense of the State, to be styled the Pennsylvania Canal," approved February 25th, 1826, provided that the commissioners appointed in the year previous, should locate and contract for the construction of a canal, from Middletown to a point on the east side of the Susquehanna river, opposite to the mouth of the Juniata; and from Pittsburgh to the Kiskiminetas; also a navigable feeder from French creek to Conneaut lake, and locate a canal thence to Lake Erie.

On the 10th of April following, a supplement was passed, authorizing the Governor to appoint four additional commissioners, thus making the board to consist of nine members.

On December 23d, 1826, the board presented a report signed by William Darlington, president, and Joseph McIlvaine, secretary, in which it was stated, that "to supply deficiencies, and, as far as possible, to examine the other routes pointed out by law, had been the object of the board in its surveys of the past season." These surveys were as follows, viz.:

First. A survey of the northern route by the Susquehanna, West Branch, Sinnemahoning, Clarion, and Allegheny rivers, from the mouth of the Juniata to the mouth of the Kiskiminetas, under the direction of Judge James Geddes, assisted by William Wilson.

Second. A survey of the Allegheny river, from the mouth of the Kiskiminetas to that of French creek by the same.

Third. A survey of the Juniata route, from the mouth of the Juniata to that of the Kiskiminetas, by Canvass White, assisted by George T. Olmstead.

Fourth. A survey of the north branch of the Susquehanna, from Northumberland to the New York line, by W. Bennett, of Luzerne county, under the superintendence of Judge Scott, a member of the board.

Fifth. A survey of routes through Cumberland and Franklin counties to the Potomac river, and by the Conococheague or Monocacy and Conewago to the Susquehanna, by John Mitchell, of Centre county.

Owing to sickness in several of the parties, and to other causes, the reports of the engineers were not received in time to be included in the report of the board.

Surveys of the routes from Philadelphia to the Susquehanna, and from the Juniata to the Potomac, were deferred on account of the large expenditure of money, and the expediency of awaiting the results of other surveys.

To carry out the provisions of the act of February 25th 1826, in regard to the commencement of the Pennsylvania Canal, General Lacock was appointed acting commisssioner on the western, and Charles Mowry on the eastern division of the canal. William Strickland was appointed engineer in March 1826, and immediately commenced the location of the canal, from Middletown to the mouth of the Juniata; and in April of the same year the location of the western division was commenced at Pittsburgh by Nathan S. Roberts.

The ground was first broken at Harrisburg on July 4th, 1826, and the contractors were generally at work on the eastern division in August, and on the western in the month following.

Considerable difficulty having occurred in regard to determining the location of the canal at Pittsburgh, Major D. B. Douglass, at that time professor of engineering at West Point, and Mr. William Strickland, engineer of the eastern division of the canal, were called upon to join the board and Mr. Roberts, in an examination of both sides of the Allegheny river, between Pittsburgh and the mouth of Kiskiminetas river. The opinions of the engineers were, however, so conflicting, that the board were compelled to decide the question, which they did, by directing the canal to be located on the western side of the Allegheny river, on such a level as would admit of its being ultimately conducted into either the Allegheny or Monongahela river.

On February 6th, 1827, the board of canal commissioners made a supplementary report, submitting the results of the surveys of the previous season, together with a report from Major Douglass, of the location and estimated cost of construction of the French creek feeder.

After reviewing the prominent features of the engineers' reports, and stating the leading objects of a system of internal improvements, the board recommended the construction of the following works: "1st. A canal from the mouth of the Juniata, or point opposite thereto, to Northumberland, thence up the north branch of the Susquehanna to the northern boundary of the State, and up the west branch to the mouth of Bald Eagle creek; 2d. A canal from the mouth of the Juniata, up that stream to Frankstown, thence by portage acrosss the Allegheny mountain to Johnstown, and thence by canal down the Conemaugh and Kiskiminetas, to join the present location of the western division of the Pennsylvania Canal at the head of the feeder."

"When to these works shall be added communication between the Delaware and Susquehanna, and between the Ohio and Lake Erie, a general system will exist, more equal in its operation upon the several sections of the State, and better calculated to effect the great purposes of internal improvement, than any other that can possibly be devised." The annual report of the board, signed by David Scott, president, was presented on December 27th, 1827, to the Governor, and by him laid before the legislature. The operations of the season are briefly summed up as follows: The board having made all necessary arrangements for the business of the ensuing season, adjourned early in February, 1827, to meet again on the first of May, by which time it was expected that the legislature would have acted definitely upon the system of improvements proposed by the commissioners.

An act was passed on April 16th, 1827, one of the sections of which limited the pay of engineers, and imposed such restrictions upon commissioners and engineers, as induced the resignation of nearly all the engineers employed or engaged by the board. The commissioners, thus suddenly deprived of valuable assistance at a critical period, were of course very much embarrassed, but they nevertheless adopted the most efficient means in their power to remedy the difficulty, and prevent any interruption to the work under contract. The care of the eastern division was assigned to Mr. F. W. Rawle, and that of the western to Mr. James D. Harris, who were to some extent familiar with the plans and details of the work. Mr. Simeon Guilford was directed to commence the location of the North Branch Canal from the mouth of the Juniata to Northumberland, and Mr. Alonzo Livermore, who had been employed on the Union Canal, was engaged to take charge of the Kiskiminetas division. At the special request of a number of the members of the legislature, Messrs. John Mitchell and William Wilson were appointed to make further examinations for a water communication between the Susquehanna and Allegheny rivers.

As the term of the board expired on the 1st of June, they adjourned *sine die,* after requesting the Governor to convene the new board on June 2d.

The following gentlemen, who had been appointed canal commissioners by the Governor, under the act of April 16th, 1827, met at Harrisburg on June 2d, namely: David Scott, Abner Lacock, Daniel Montgomery, Thomas Enoch, Charles Mowry, John Phillips, Jonathan Roberts, and James Clarke, and organized by the election of David Scott as president, and Joseph McIlvaine as secretary.

At this meeting engineers were appointed and assigned as follows, viz.: De Witt Clinton, Jr., of New York, to the Juniata line; Major John Wilson, formerly of the United States topographical engineers, and subsequently chief civil and military engineer of the State of South Carolina, to the surveys between the Delaware and Susquehanna rivers; John Randal, Jr., of Pennsylvania, to survey along the north branch of the Susquehanna; and Charles F. Whippo, of New York, to the Beaver and Shenango surveys. In addition to these, Major D. B. Douglass was requested to employ the period of recess at the West Point

Military Academy, in exploring the route between Conneaut Summit and Lake Erie.

The survey of a canal line along the Delaware river from Easton to Philadelphia, was made by Mr. Sargent during July and August, after which, by the direction of the board, a line of 18 miles in length, from Bristol upward, was located and placed under contract on October 13th, 1827.

The Juniata Canal, from Duncan's Island to Lewistown, was also located by De Witt Clinton, Jr., and contracted for.

In June, Major Wilson commenced his surveys at Valley Forge, on the Schuylkill river, about nineteen miles above Philadelphia, and continued westward along the great valley of Chester county, by Downingtown and Coatesville, to the summit of the Mine Ridge at the Gap, making a very thorough examination of the country by branch lines, and gauging all the streams that were intersected. The results being such as to satisfy him of the impracticability of constructing a canal along the route examined, he discontinued the survey at the Gap, and proceeded to comply with the further instructions of the board of canal commissioners, by making a survey for the extension of the eastern division of the Pennsylvania Canal from Middletown to Columbia. This duty was scarcely accomplished, when his entire party was prostrated by sickness, and operations were necessarily suspended for several weeks. Upon return to the field, attention was given, first to examinations between the Susquehanna river and the Gap, and then to completing the surveys previously made east of the Gap, in conformity with the instructions of the board, which directed an "examination, survey, and estimate of a route for a railway, from Philadelphia, through Chester and Lancaster counties, so as to connect by the nearest and most eligible route, with the eastern division of the Pennsylvania Canal."

The surveys not having been completed until November 29th, a hurried report was prepared and submitted on December 17th, in order that it might be included in the annual report of the commissioners.

A supplementary report was submitted on January 12th, describing the plans upon which it was proposed to construct the road, and giving an approximate estimate of cost; but the surveys having only been preliminary, considerable changes were subsequently made, both in route and plan.

The regular party employed under Major Wilson during the summer of 1827, consisted of George Haines, leveler; David Truman, surveyor; Robert Pettit, rodman; John Edgar Thomson, Charles Brown, and William Hasell Wilson, chainmen, of whom the only survivor at this time is W. Hasell Wilson, for many years chief engineer, and now consulting engineer, of the Pennsylvania Railroad.

"An act relative to the Pennsylvania Canal, and to provide for the commencement of a railroad," was approved March 24th, 1828. The canal commissioners were required by the first section, to locate, and contract for the construction of a canal from Middletown to Columbia, and for an extension of the Juniata Canal above Lewistown; by the fourth section, to locate a railroad across the Allegheny mountain; and by the fifth section, "to locate a railroad from Philadelphia, through the city of Lancaster, to Columbia, and thence to York, such part of which, east of the Susquehanna, to be put under contract during the present year, as the canal commissioners may deem expedient, with a view to completion within two years."

The annual report of the canal commissioners, dated December 11th, 1828, gives the following summary of the year's work:—

Seven additional miles of the Delaware division of the Pennsylvania Canal were placed under contract on May 20th, eighteen miles on September 18th, and ten and a half miles on November 18th, under the direction of H. G. Sargent, engineer.

In March, Charles T. Whippo was appointed engineer of the canal on the north branch of the Susquehanna river. He immediately commenced the location, and placed under contract, on July 24th, twenty-seven miles, from Nanticoke Falls downward, and later in the season the remaining distance of twenty-seven miles to Northumberland.

On the west branch of the Susquehanna, twenty-three miles of canal, from Northumberland to Muncy, were located, and placed under contract on October 1st, by Mr. F. W. Rawle, engineer.

In October, contracts were entered into for the construction of forty-five miles of canal along the Juniata river, from Lewistown to a short distance above Huntington, under the direction of De Witt Clinton, engineer.

Contracts were also made during the year for ten and a half miles of the French creek feeder, under James Ferguson engineer; for twenty-seven miles of canal along the Conemaugh, from Blairsville upward; and for ten miles on the eastern division, between Columbia and Middletown. The latter work was under the charge of Samuel H. Kneass, while the engineers on the western division, between Pittsburgh and Johnstown, were James D. Harris and Alonzo Livermore.

Surveys were made by Nathan S. Roberts for a portage over the Allegheny mountains, between the Juniata and Conemaugh canals; by Moncure Robinson between the Delaware and north branch of the Susquehanna; by Major D. B. Douglass, for an extension of the Delaware Canal from Easton to Carpenter's Point; by Simeon Guilford on the Susquehanna below Northumberland; by Edward F. Gay on the Allegheny, Monongahela, and Ohio rivers; and by William R. Hopkins, for a railroad from Harrisburg to Chambersburg, and thence to York.

In April, Major John Wilson commenced, at Columbia, the location of the railroad between that place and Philadelphia, with the following corps: Joshua Scott, principal assistant; Robert Pettit and John Edgar Thomson, assistant engineers; John P. Baily, Samuel W. Mifflin, William Hasell Wilson, and J. Brinton Moore, rodmen; William J. Lewis, William W. Torbert, Joseph G. Davis, and A. S. Green, chainmen, the last of whom soon left the service, and was replaced by James Moore.

Henry R. Campbell was subsequently added as assistant engineer, and the corps continued as thus organized to the close of the season.

As the Columbia and Philadelphia Railway was one of the earliest important works of the kind constructed in America, and, in fact, the first railroad undertaken in any part of the world by a government, a brief review of the condition of railway science, at the time of its commencement, will not be out of place here.

Mr. Nicholas Wood, civil engineer, the author of a valuable treatise on railroads, the first edition of which was published in

1825, remarks that at that time "railways were, so far as regards their application to general purposes, quite in a state of infancy." "With the exception of the Surrey, and the Stockton and Darlington railways, they had been almost exclusively confined to private purposes, for the conveyance of coals, lead, iron, &c., from the great coal, lead, and iron works. Being thus blended with and forming part of a general establishment, though their utility to complete the operations of such works was never questioned, it yet remained to be proven how far they were applicable and useful as an independent and distinct mechanical process, for the purpose of general traffic. The example of the Surrey, which was a tram railway, tended to produce an unfavorable opinion in this respect, and the Stockton and Darlington, though in a very advanced state, was not then brought into operation."

As early as 1824, experiments were made with locomotive engines, but, up to the year 1829, the results obtained were not such as to inspire confidence in their availability for quick rates of speed. In 1828, a deputation of the directors of the Liverpool and Manchester Railway visited the principal railways then in operation, for the purpose of examining the different varieties of motive power in use, but returned without being able to decide which kind was the most advantageous to their interests; their opinion, however, was strongly adverse to horse power, and rather in favor of stationary engines.

Mr. George Stephenson, the company's engineer, was next sent to make examination, and, in his report to the directors, he expressed himself decidedly in favor of locomotive engines. In consequence of the reports differing, it was concluded to employ two engineers to give the subject their full consideration, and Messrs. James Walker and J. U. Rastrick were appointed to inspect the railways in the north, and report the result of their observations. The conclusions of these gentlemen were, that stationary engines were preferable, and they accordingly recommended their adoption. Nevertheless, there was so strong a leaning, on the part of a majority of the directors, in favor of locomotives, supported by the opinion of their engineer, Mr. George Stephenson, that it was finally determined in April, 1829, to offer a premium of £500 for the best locomotive engine, subject to certain stipulations and conditions. The only one of the conditions necessary to be mentioned here is, that "the engine, if it weighs six tons, must be capable of drawing after it, day by day, on a well constructed railway, on a level plane, a train of carriages of the gross weight of 20 tons, including the tender and water tank, at the rate of 10 miles per hour." This offer induced the competition at Rainhill, in October, 1829, when five engines were entered for the prize, which was awarded to the Rocket, of Mr. Robert Stephenson. While the performances on this occasion did not give any extraordinary results in favor of the economy of transportation by the use of locomotives, they showed a great advance over what had previously been accomplished, and inspired a confidence in further improvement, which practically settled the question as to the kind of motive power to be adopted for the road.

The Liverpool and Manchester Railway, which was the first important line in Great Britain for general traffic, was opened for public use at the close of the year 1830. The length of the road is 31 miles, of which about 18 were laid with stone blocks, and 13 with wooden sleepers, the latter being over the embankments. The rails were of rolled iron of the fish-belly pattern, weighing 35 pounds per lineal yard, and were fastened to the blocks and sleepers by cast-iron chairs, in which they were secured by keys or wedges.

On the 1st day of December, 1830, Mr. Stephenson's engine, "Planet," weighing about six tons, took the first train load of merchandise through from Liverpool to Manchester. The train consisted of eighteen wagons, containing 51½ tons, which, with the weight of wagons, tender with water and fuel, and fifteen persons, gave a gross weight of 80 tons, exclusive of the engine. The time occupied in making the trip of 31 miles, was 2 hours and 54 minutes, the greatest speed on the level portions of the road being at the rate of 15½ miles per hour.

The Stockton and Darlington Railroad, extending from Stockton, on the river Tees, to the coal mines, a distance of 25 miles, was brought into use in the year 1825, and was the first railroad in Great Britain upon which passengers were regularly conveyed.

It had two summits, upon each of which a stationary engine was placed, operating the opposing inclined planes. Between the planes horses were at first used, but they were subsequently superseded by locomotive engines. The curves were of short radius, and the profile undulating, varying from a level to an inclination of 51 feet per mile. The track was formed of malleable iron rails, weighing 28 pounds per yard.

Several other railways were in use in Great Britain previous to 1830, but they were of short extent, generally for the purpose of conveying mineral products, and not intended for passengers or rapid traveling.

The first railway of any considerable extent constructed in France, was from St. Etienne to Andrezieux, 13 miles in length, completed in the year 1828. The rails were of cast iron, weighing 43 pounds per yard. The curves were often abrupt, having a minimum radius of 240 feet. The road was operated by horses.

The railroad from St. Etienne to Lyons, 34 miles in length, was commenced in the year 1826, but not opened throughout until 1831. No expense was spared to make this road as perfect as possible. To obtain easy grades and good alignment, fourteen tunnels were constructed, and 500 metres, or about 1,641 feet, adopted as the minimum radius of curvature. The rails were of wrought iron, in fifteen-feet lengths, weighing 26½ pounds to the yard, and laid upon stone blocks of about one cubic foot each, placed three feet apart from centre to centre.

There were some other railroads constructed in Europe, the most important of which was the one from Budweis in Bohemia, to Lintz in Austria, a distance of 80 miles, one-half of which was opened for use in 1829. The track was formed of wooden string-pieces, resting on cross-sleepers, and plated with iron two inches in width by one third of an inch in thickness. The maximum gradient was 44 feet per mile, and the minimum radius of curvature 621 feet.

The Quincy Railroad, three miles in length, used for transporting granite from the quarries to the landing on Neponset river, in the state of Massachusetts, was built in the year 1827. About the same time several short pieces of railroad were constructed in Pennsylvania for similar purposes, but the first railroad for any extent made in the United States was the Mauch Chunk, nine miles in length, for the purpose of conveying coal to the Lehigh river, which was completed in 1827.

The railroad from Carbondale to Honesdale, about 16 miles in length, was commenced in 1827, and completed in 1829, up to which time the few railroads constructed in the United States were laid with wooden string pieces, plated with flat iron bars and operated by horse power, with the exception that on a portion of the road last named, stationary steam engines were used.

From the brief history just given, it will be seen that at the close of the year 1828, when it became necessary to adopt specifications to govern the construction of the Philadelphia and Columbia Railway, experience in the construction and operation of railroads was very limited. The Stockton and Darlington, which in the course of a few years was found to possess many defects, was at that time considered the most important road in operation.

The opening of the Liverpool and Manchester Railway in 1829, was the beginning of a new era, in which a complete revolution was made in the construction and operation of railways.

In the year 1825, Mr. William Strickland, civil engineer, was sent to England by the "Pennsylvania Society for the Promotion of Internal Improvements," "to collect information of all the valuable improvements in canals, roads, railways, bridges, and all other information calculated to promote the objects of the society." His reports, which were published during the year following, under the authority of the society for whom they were made, contained much valuable information on the several subects designated for examination, especially in the construction of canals; but at that time railways were only beginning to attract attention for purposes of general traffic, and the information given in relation to them was neither full nor important.

About the same time that the spirit of improvement began to develop itself in Pennsylvania, the citizens of Baltimore were moved to undertake the bold and important enterprise of building a railroad to the Obio river. A charter was obtained in

1827, and work commenced in the latter part of 1828. While the surveys were progressing, the company sent a delegation of engineers to England, to obtain the latest information in regard to railway construction, and no effort nor expense was spared to have all their work planned and executed in the most thorough manner. On the eastern portion of the road the viaducts were with a few exceptions constructed entirely of masonry, and the tracks formed of granite sills laid longitudinally, surmounted by flat iron bars. The opinion was entertained, that a track composed of such indestructible materials as iron and granite would endure for an unlimited time. The experience of but a few years, however, was sufficient to demonstrate the fallacy of this idea, as well as of many others connected with railway construction, which was then, and for some time subsequently, only a series of experiments.

Major Wilson, in a report to the canal commissioners, dated August 15th, 1828, described the surveys and location of a line for the railway from Columbia to the summit of the Mine Ridge, at the point known as the Gap, a distance of 29 miles, with an estimate of the cost of grading and masonry. On December 1st, of the same year, he made report of the remainder of the line to its terminus at Broad and Vine streets, in the city of Philadelphia, making the total distance to the latter point, from the head of the inclined plane at Columbia, $82\frac{8}{10}$ miles. In this, which should be considered as a preliminary location, the maximum gradient adopted was $29\frac{8}{10}$ feet per mile, and the minimum radius of curvature 541 feet, or seven degrees to a chord of 66 feet, the four-pole chain being the unit of measurement. In the revisions of the located line made previous to construction, the length was reduced to $81\frac{6}{10}$ miles, and the limit of curvature to a radius of 631 feet, or six degrees to a chain.

The prominent features of the road as constructed may be summed up as follows: Commencing at Broad street, at its intersection with Vine street, which was then the northern limit of the city, the line took a northwesterly direction, passing near the Fairmount Water-works, and crossing the Schuylkill river just below Peters' island. Immediately west of the river was an inclined plane of 2,805 feet in length, and 187 feet in height, at which stationary steam power was used. From the head of the plane the line continued along the dividing ridge between waters flowing into the Delaware and Schuylkill rivers, for about 19 miles, attaining an elevation of 543 feet above tide; it then descended into the great Chester valley, which it followed with undulating grades to the crossing of the West Brandywine creek, a further distance of about 18 miles. It then ascended the southern slope of the northern ridge to the summit at the Gap, where its elevation above tide was 565 feet.

According to the first location, a cut of 37 feet would have been required at this point, but after a few feet of the surface was removed, the material below proved to be quicksand; after incurring much expense and delay in fruitless attempts to attain the required depth, the cutting was reduced by raising the grade for one mile on each side of the summit to about 44 feet per mile. Even with this change considerable difficulty was experienced, but eventually the revised grade line was reached, and the tracks secured on piles.

From the Gap the line descended into Pequea and Conestoga valleys, and, passing through the city of Lancaster, continued to the borough of Columbia, where an inclined plane of 1,800 feet in length and 90 feet in height, brought it to the margin of the Susquehanna river and the terminal basin of the Pennsylvania canal.

The location of the Philadelphia terminus of the railroad was the subject of much controversy and excitement, in which the corporate authorities of the city proper and the suburbs, as well as many prominent individuals, took an active part. Messrs. Moncure Robinson, and William R. Hopkins, and Major D. B. Douglass, eminent civil engineers, were called upon to examine and report upon the various routes suggested, and elaborate surveys were made under their direction, all of which, however, resulted in the establishment and confirmation of the location made by Major Wilson.

In accordance with an act of the Legislature, and by direction of the board of canal commissioners, the grading and bridging of 40 miles of the railroad were put under contract in April, 1829. In deference to sectional feeling, 20 miles were taken at each end, the eastern portion extending westward from the foot of the inclined plane at the Schuylkill river. The work was prosecuted vigorously, and, with the exception of a few of the heaviest sections and some of the bridge superstructure, completed within the year.

In December, 1828, Mr. Moncure Robinson was appointed by the board of canal commissioners, engineer of the Allegheny mountain portage, with instructions directing his attention to three points: "1. The construction of a railway overcoming the summit by means of stationary engines or self-acting planes. 2. The construction of a macadamized turnpike of the best kind between the same points. 3. The suggestion of any other plan which might occur to him as calculated to afford the best accommodation to trade." Mr. Robinson, in his report to the commissioners, dated November 21st, 1829, expressed his views and opinions fully on the points submitted to him, concluding with a very decided recommendation of the railroad as the most eligible plan of improvement.

The work on the several lines of canal was diligently prosecuted during the year, and portions brought into use. The charge of the Juniata division passed into the hands of Alexander C. Twining, engineer.

From the report of the canal commissioners, at the close of the year 1830, the following synopsis is obtained of the condition of the public works at that time. The forty miles of railroad between Philadelphia and Columbia were prepared to receive the rails, no further work having been authorized. On the eastern division of the canal 24 miles were navigable, and 10 more were nearly completed. One and a half miles of the Susquehanna division, from Duncan's Island to the Juniata, and 80 miles of the Juniata division, were navigable. The western division of the canal, from the head of the basin at Johnstown, to the Monongahela river at Pittsburgh, 104 miles in length, was navigable throughout. The Susquehanna division, from Duncan's island to Northumberland, 39 miles, was in navigable order. The West Branch division, from Northumberland to a point above Muncy, 23½ miles, was navigable. The water had been let into the North Branch division of 55½ miles in length, from Northumberland to Nanticoke, but the canal was not quite ready for use. About twenty-five miles of the Delaware division, between Bristol and Easton, were in navigable condition. The work done by the Commonwealth up to this date, making a grand total of 40 miles of road-bed prepared for the rails, 298 miles of navigable canal, 55 miles nearly completed, and a considerable amount in various stages of progress, for which the total expenditure amounted to $10,283,768.

Under the provisions of an act of the Legislature, passed in March, 1830, the board of canal commissioners appointed Moncure Robinson, Col. Stephen H. Long, and Major John Wilson, engineers to make examination of the different routes for crossing the Allegheny mountain. They were instructed by the board "to take into view a portage by means of a road so graded as to admit of its being adapted either to a macadamized turnpike or to a railroad."

Two of the engineers having had "no personal knowledge of the localities to be traversed by the contemplated road, nor of the nature of the obstacles to be overcome," deemed it necessary to institute a course of examination and surveys, and with this view a party was organized under the immediate direction of Col. Long, and employed from the beginning of August until the close of the year. A brief report upon the general features of the case, was presented by Col. Long and Major Wilson, immediately after the completion of the surveys, in order to be included in the annual report of the commissioners to the Legislature, which was required to be made in December. Early in the month of March succeeding, a report in detail was submitted by Col. Long, accompanied by plans and estimates. This was followed by one from Mr. Robinson, reviewing and sustaining his report of the previous year. While all of the engineers concurred in deeming a railroad preferable to a turnpike, and in recommending the route crossing the mountain at Blair's Gap, there was some difference of opinion among them as to details, the principal points involved being the adoption of a tunnel at the summit, and the character of the inclined planes. Mr. Robinson advocated the tunnel, and urged very strongly the importance of having the planes straight, even at an increase of the angle of inclination, which, in the planes located by him, varied from three and a half to nine degrees, and in one instance to a still higher figure. The other two engineers were desirous "to obviate the necessity for a tunnel until such time as the exigencies of the trade upon the road should require it, and to avoid the adoption of inclined planes having a greater inclination than five degrees, and, if possible, to limit their inclination to three degrees."

The canal commissioners, in their report, evidently favored the construction of a railroad in preference to a turnpike, but avoided making a decision, referring the legislature to the reports of the engineers for further information, and leaving to them the settlement of the question.

No appropriation having been made by the legislature at the session of 1829 and 1830, for the prosecution of further work upon the Columbia Railway, nothing more was done during the year 1830, than to complete the contracts made during the previous year, which extended only to the grading and bridging of twenty miles at each end of the road. Under these circumstances a reduction of the engineer corps became necessary, which took effect in June, 1830.

Major Wilson having, with the consent of the canal commissioners, entered into an engagement with the Camden and Amboy Railroad Company to make a location of their road, organized a corps of engineers for that purpose, into which he transferred several of his assistants from the Columbia Railway, leaving merely sufficient force to attend to the unfinished work.

At this stage of our history, a brief allusion to the individual members of the corps engaged on the surveys and location during the year 1828, may not be uninteresting. Joshua Scott, principal assistant engineer, was a well-known and highly-respected citizen of Lancaster, who had established a reputation as a skillful and reliable engineer. His map of Lancaster county, prepared with great care and accuracy from his own surveys, is to this day the standard authority for the topography of that county. He left the service on the completion of the surveys at the end of the year, having only engaged for that duty. He was at that time past middle age, and has been dead for many years.

Robert Pettit, assistant engineer, continued on the road in that capacity until 1831, when he took charge of the receipt and distribution of iron rails for the Columbia Railway, and subsequently for the Portage Railroad. After the completion of the latter work, he entered the United States navy as purser in April 1837, in which service he continued as paymaster and pay director until his death in May 1878.

John Edgar Thomson, chainman in 1827, assistant engineer in 1828, and principal assistant in 1829, accompanied Major Wilson in June, 1830, to the Camden and Amboy Railroad, as principal assistant in charge of one of the locating parties. The engagement of Major Wilson and his corps terminated with the completion of the location. Mr. Thomson visited Europe in 1831, and in 1832 was appointed chief engineer of the Georgia Railroad, which position he held until 1847, when he entered upon the duties of chief engineer of the Pennsylvania Railroad. In 1852 he was elected president of the Pennsylvania Railroad Company, and continued to hold that office until his death on May 27th, 1874.

Henry R. Campbell remained on the Columbia Railway as assistant and principal assistant engineer until February, 1832, when he received the appointment of chief engineer of the Philadelphia, Germantown and Norristown Railroad. Since the completion of that work he has occupied similar positions on several other roads in the northern and eastern States.

John P. Baily continued in the service until March, 1833, having advanced to the rank of principal assistant engineer. For some years subsequently he was engaged on engineering duties in various parts of the United States, serving during the years 1836, 1837, and 1838, as chief engineer, under the canal commissioners of Pennsylvania. In 1839, or soon after, he retired from the profession and studied law, which he subsequently practiced at West Chester, where he was for some time an associate judge of the county court, and where he died in 1876.

Samuel W. Mifflin became assistant engineer in 1829, and served in the same capacity on the location of the Camden and Amboy Railroad in 1830; he returned to the Columbia Railway in 1831, and continued until May, 1833. From that time he was engaged in various professional duties until 1847, when he took a position as principal assistant engineer under Mr. Thomson, on the Pennsylvania Railroad, remaining until the construction was well advanced. Since leaving that work, he has been chief engineer on the Huntingdon and Broad Top Railroad and several other lines, and is still engaged in the practice of his profession.

J. Brinton Moore, as assistant engineer, had charge of construction on the western division of the Columbia Railway until 1833, but is supposed to have abandoned the profession not long after.

W. Hasell Wilson, chainman on the surveys of 1827; rodman on the location of 1828; assistant engineer on construction in 1829 and 1830; and principal assistant in charge of the eastern forty miles of the road, from March, 1831, until October, 1834, when the work was completed and the engineer corps disbanded. In the spring of 1835 he took charge, as principal assistant under Messrs. Moncure and Wirt Robinson, of the final location and construction of the second division of the Philadelphia and Reading Railroad, between Pottstown and Norristown. In June 1838, the work under his care being nearly completed, he was appointed by the canal commissioners of the State, chief engineer of the Gettysburg extension of the Pennsylvania Railroad, which position he held until the stoppage of the work in the following year. His attention for several years subsequent was directed to other pursuits, but he returned to the practice of his profession in 1852, and was chief engineer of the West Chester and Philadelphia Railroad in 1854 and 1855. Upon the purchase of the main line of the state improvements by the Pennsylvania Railroad Company in 1857, he was placed in charge of the Columbia Railway, and in 1859 became chief engineer of the entire line from Philadelphia to Pittsburgh. At the close of the year 1873, the engineer department as a separate organization was discontinued, since which date he has continued in the service of the company as consulting engineer and head of the department of real estate.

The four chainmen were advanced by regular promotion to the rank of assistant engineer in 1831. Joseph G. Davis left the service in that year. William W. Torbert continued on the road until the completion of the work in 1834, after which he was engaged for some time in Georgia with Mr. Thomson, but subsequently withdrew from the profession. William J. Lewis and James Moore resigned in the early part of 1832, to accompany Mr. H. R. Campbell to the Philadelphia, Germantown and Norristown Railroad, and have since filled important positions in various parts of the country. The former has for many years resided in California, where he has been engaged in the practice of his profession; the latter is now general superintendent and chief engineer of the Central Railroad of New Jersey, with which he has long been connected.

In March, 1831, the legislature made a liberal appropriation, and directed a vigorous prosecution of work on the several lines that had been commenced, besides authorizing the construction of some others, including the Portage Railroad over the Allegheny Mountain, with a proviso excluding a tunnel at the summit.

Before proceeding with our description, it will be interesting to notice an announcement made in the Pittsburgh papers of May, 1831, that Reeside Slaymaker & Co. had, "with their usual enterprise and public spirit," established four lines of stages to run through to Philadelphia; the first, in two and a half days; the second, in four days—both of these daily; the third to start tri-weekly; and the fourth to run daily in four days, by the way of Blairsville, Huntingdon, and Lewistown. This was considered at the time a great advance upon previous traveling facilities. The writer well recollects the advent of the fast mail line to run through in two and a half days. The coaches were built as light as possible consistent with strength, and carried but six passengers each. The four-horse teams were carefully selected, and changed every ten miles. As the sound of the horn announced the approach of the stage to the changing station, the fresh horses were brought out, each in charge of a groom, and the change effected, and the coach rolling away before the passengers hardly realized what was being done. The contrast with the old order of things was so marked, as to excite a good deal of wonder and astonishment along the route.

During the year 1831, Mr. Stevenson, president of the board of canal commissioners, died, and was succeeded by Mr. James

Clarke, who had been identified with the improvement system from the beginning, and who continued to be the leading spirit of the board as long as the state owned and controlled the works. Mr. Clarke was a very strong advocate for canals; the tenacity with which he adhered to his opinion of their superiority over railroads, is shown by the following extract from the annual report of the canal commissioners in December, 1831: "While the board avow themselves favorable to railroads, where it is impracticable to construct canals, or under some peculiar circumstances, yet they cannot forbear expressing their opinion, that the advocates of railroads generally have greatly overrated their comparative value. To counteract the wild speculations of visionary men, and to allay the honest fears and prejudices of many of our citizens, who have been induced to believe that railroads are better than canals, and, consequently, that for the last six years the efforts of our state to achieve a mighty improvement have been misdirected, the canal commissioners deem it to be their duty, to state a few facts, which will exhibit the comparative value of the two modes of improvement for the purpose of carrying heavy articles cheaply to market, in a distinct point of view."

After going into an estimate of the cost of transportation by both methods, the report proceeds: "The introduction of locomotives and Winans cars upon railroads where they can be used to advantage, will diminish the difference between canals and railroads in the expense of transportation. But the board believe, that notwithstanding all the improvements which have been made in railroads and locomotives, it will be found, that canals are from two to two and a half times better than railroads for the purposes required of them by Pennsylvania."

"The board have been thus explicit, with a view to vindicate the sound policy of the commonwealth in the construction of her canals; yet they again repeat, that their remarks flow from no hostility to railroads, for next to canals they are the best means that have been devised to cheapen transportation. They are valuable in many situations, and particularly along courses of great thoroughfare which will bear the expenses of their construction. They can be made to carry the United States mails and passengers, and also light valuable goods, where time is of more importance than cost of transportation."

The system of improvements having been fairly inaugurated, it will be found more satisfactory in the further description, to take up each line or division separately, and follow it to completion.

The most important of the state works, was the main line between Philadelphia and Pittsburgh, which was composed of four sections or divisions, viz., the Columbia Railway; the Eastern division of canal; the Portage Railroad; and the Western Division of canal.

COLUMBIA RAILWAY.

The Columbia Railway, as previously stated, extended from the intersection of Broad and Vine streets, in the city of Philadelphia, to the canal basin at Columbia, a distance of 81$\frac{6}{10}$ miles. The prominent features of the road have already been described, and mention made, of twenty miles at each end having been graded and bridged ready for the rails at the close of the year 1830.

In May 1831, the grading and bridging of the middle section of about 37 miles, of the 3 miles between the foot of the inclined plane and Broad street Philadelphia, and of one mile adjacent to the basin at Columbia, were placed under contract, and the construction of track commenced on the eastern portion previously graded. The track laying was continued as successive sections of the road-bed were prepared, and as the appropriation of funds permitted.

The original location of the railway passed immediately north of the city of Lancaster, but after the formation of the road-bed, at the request of the citizens of that place, the legislature authorized a change of route, by which the line was taken through the heart of the city, upon condition that the additional cost should be defrayed by the city, which was done.

On September 20th, 1832, a single track was opened for travel, from the head of the Schuylkill inclined plane, to the junction of the West Chester Railroad, about 20 miles. On April 16th, 1834, cars passed through from Philadelphia to Columbia on the single track, and on October 7th of the same year, both tracks for the entire length of the road were opened for public use. Fifty-seven miles of the line were straight, and the remaining $24\frac{6}{10}$ miles curved, with radii ranging from 631 to 3,782 feet. The road-bed was graded 25 feet in width. The deepest cutting on the line was forty feet, and the highest embankment 80 feet. Two stationary engines, of 60 horse-power each, were erected at the head of the Schuylkill inclined plane, and two, of 40 horse-power each, at the head of the Columbia plane. The arched culverts 75 in number, with spans varying from 4 to 25 feet, as well as a considerable number of box culverts, were all built of stone. There were 22 railway bridges or viaducts, constructed with stone abutments and piers, surmounted by timber superstructure; and 33 overhead bridges for public and farm roads. The following were the most important structures:—

Schuylkill viaduct, having seven spans, the clear lengths of which between the piers were, two of 122 feet each, three of 135 feet each, and two of 137 feet each. The abutments and piers were constructed of coursed and hammer-dressed masonry, from the bottom of the foundations, which were on rock, with the exception of the western abutment and two adjacent piers, which were founded upon hard gravel. Five of the piers were in the river and required coffer dams; one of them stood in 26 feet depth of water. The wooden superstructure was 1,045 feet in length by 49 feet in width, with four trusses on a modification of the Burr plan, having a passage way of four feet in the middle for foot travelers, and one of 18½ feet on each side for railway and common road respectively. The height of the bridge floor above ordinary water line was 38 feet.

Valley Creek viaduct consisted of four spans of 130 feet each in clear, with a height from water to floor of 60 feet.

East Brandywine viaduct had four spans of 89 feet each in clear, with a height of 30 feet.

West Brandywine viaduct, had a length of platform of 835 feet, divided into six spans, resting upon abutments and piers of coursed masonry. The railway tracks rested upon the upper chords of the trusses, at an elevation of 72 feet above the water of the creek.

Pequea viaduct was one span of 130 feet.

Mill Creek viaduct, comprised four spans with a total length of 550 feet, and a height from water to floor of 40 feet.

Little Conestoga viaduct, had a superstructure 804 feet in length, elevated 47 feet above the stream.

All of the above-named bridges, were constructed according to a modification of the Burr plan.

The viaduct over Big Conestoga creek, had a superstructure on the Town lattice plan, 1412 feet in length, at an elevation of 60 feet above the water line. The spans were of various lengths, the longest being 120 feet.

The abutments and piers of all the viaducts, except those at the Schuylkill river and West Brandywine creek, were constructed of rubble masonry.

The length of the road being as before stated 81$\frac{6}{10}$ miles, there were 163$\frac{2}{10}$ miles of single track exclusive of sidings and crossings; of which, 6 miles were laid with granite sills, plated with flat iron bars, 2½ inches in width by five-eighths of an inch in thickness; 18 miles with wooden string-pieces plated in a similar manner; 2 miles with stone blocks and edge rails, having stone sills extending across the track at intervals of 15 feet; and 137$\frac{2}{10}$ miles with stone blocks and edge rails, having wooden cross-ties intermediate, except on some of the embankments, where the edge rails were secured to cross ties supported on longitudinal mud-sills. The English gauge of 4 feet 8½ inches was adopted for this road, and the tracks were placed 4 feet 6 inches apart. The granite sill track, which was similar to that laid on the eastern portion of the Baltimore and Ohio Railroad, and in regard to the permanency and efficiency of which great expectations had been formed, proved an entire failure. Although the sills were bedded on a stratum of broken stone one foot in depth well rammed, it was found impracticable to keep them either to an even surface or to gauge, and after a very short period of use, the iron bars began to work loose, curling up at the ends and forming what were termed "snake heads." The wooden track was also liable to the defect last mentioned, and as the timber soon commenced to decay, it became unsafe especially for locomotives. In the course of a few years, all of the flat bar track was replaced by T rails laid upon cross ties. The edge rails, of which the greater portion of the road superstructure was formed, were rolled iron of the Wigan pattern, three and a half inches in depth, with the bottom and top surfaces parallel, weighing 41¼ pounds per yard. Cast-iron chairs of 15 pounds weight, were secured to the blocks or ties placed three feet apart, and the rails secured in the chairs by wrought-iron wedges, one on each side. The rails were at first ordered in lengths of 15 feet for straight lines, and 9 feet for curves, under the supposition that they would be too rigid to adapt themselves to a curve; but it was very soon discovered, that they could without difficulty be forced into curved lines, and that the longer the rail the more easily this could be effected; consequently the 15-feet rails were taken for the curves, and the 9-feet rails made use of on straight lines. Subsequently the rails were all procured in lengths of 18 feet, and placed so as to break joint, with a cross-tie at every 9 feet. The rails, which were procured from the Ebbw Vale Iron Works in Wales, cost upon the wharf at Philadelphia prices ranging from $44½ to $50½ per ton. The iron was of such excellent quality, that the old rails remaining after the road came into possession of the Pennsylvania Railroad Company in the year 1857, were re-rolled into rods for blacksmith purposes.

As the road was intended to be operated by horse power, and so used for several years, the space between the rails of each track, was filled in with broken stone or gravel to form a horse path.

All the cars for both passenger and freight, were owned by individuals or transportation companies, who furnished their own teams of horses or mules, and paid to the State for the use of the road, the rates of toll established by the canal commissioners. After steam motive power was provided by the State, an additional rate was paid by those transporters who availed themselves of it.

The legislature passed an act on April 15th, 1834, authorizing the canal commissioners to place locomotive engines upon the Columbia Railway, and two were in use before the close of the year. During the year 1835 the number was increased to seventeen, of which five were manufactured by Robert Stephenson of

England, and the remainder at Philadelphia, ten by M. W. Baldwin, one by Coleman Sellers & Sons, and one by Long & Norris. The increasing business of the road demanding a corresponding increase of motive power, additional engines were procured from time to time, and the use of horses gradually discarded. All of the locomotives subsequently placed upon the road, were of American manufacture.

The successful operation of locomotive engines, with the demonstration of their ability to surmount heavier grades than had at a short time previous been deemed practicable, taken in connection with the expenses and delays attendant upon the use of the inclined plane, drew attention very soon after the opening of the road, to the subject of avoiding them. In the latter part of the year 1836, a new route was located to avoid the inclined plane at Columbia, and the work was placed under contract on November 30th of that year. In consequence of the insufficiency of appropriations, the improvement was not made available until March 4th, 1840. The length of the new line was 6½ miles, the maximum grade $39\frac{4}{10}$ feet per mile, the average grade about 35 feet per mile, and the minimum radius of curvature 1,273 feet.

Surveys for the avoidance of the Schuylkill inclined plane, were commenced during the year 1837, and continued at intervals by various engineers, until the country adjacent to the eastern terminus of the railway had been thoroughly explored, and every possible route examined, estimated, and discussed. In anticipation of a change of line, extensive renewals of track on the eastern ten miles of the road had been avoided, until the condition of the tracks became such, that at the close of the year 1848, it became absolutely necessary that decided action should be taken, and either a new road constructed, or the tracks on the old road-bed renewed. It was also evident, that additional facilities should be provided at the terminus, to accommodate the already largely increased trade, and to meet the further increase, which might be expected from the opening of the Pennsylvania Railroad between Harrisburg and Pittsburgh, then in course of construction. On these accounts it was not only important but indispensable, that the question of permanent location should be determined. The subject being thus presented to the attention of the legislature, after a careful review of all the proposed routes, the one known as the West Philadelphia route was adopted, and an appropriation made for its construction. The work was placed under contract in August 1849, and so far completed, that one track was opened for use on October 15th 1850. The new line commenced at a point about five miles west of the head of the inclined plane, and terminated at the west end of the Market street bridge over the Schuylkill river. The length was $7\frac{65}{100}$ miles, the maximum grade $49\frac{1}{10}$ feet per mile for three and a half miles, the average grade about 43 feet per mile, and the minimum radius of curvature 1,500 feet. The extension of the railway to Broad street, a distance of about one mile, and the reconstruction of the Market street bridge to adapt it for railroad purposes, were undertaken by the city of Philadelphia.

The portion of the old road between the foot of the inclined plane and Broad street, including the bridge over the Schuylkill river, was sold to the Philadelphia and Reading Railroad Company, and has since been used as a part of their main line. The remaining part, from the foot of the inclined plane westward to the point of divergence, was subsequently sold to the same company, but the materials were removed and the road abandoned.

The total cost of the Columbia Railway, including the changes of line, was reported by the Auditor-General and State Treasurer in 1854, at $5,277,278.

Major John Wilson, who made the preliminary surveys in 1827, continued in charge as chief engineer until his death in February 1833, and was succeeded by Mr. Edward F. Gay, under whose direction the work was completed in the following year, according to the original designs.

Before leaving the subject of the Columbia Railway, the following remarks will not be inappropriate:—

During the location and the early part of the construction of that road, the ordinary surveyor's compass was used for marking out the alignment; but it was soon discovered, that this instrument was not sufficiently accurate for the purpose of defining the curves and tangents for track-laying; while on the other hand, the theodolite was too heavy and complicated for rapid field work, besides being very inconvenient and liable to error, unless extraordinary care was used, in running by back and forward rights. At the suggestion of Mr. J. Edgar Thomson and other members of the engineer corps, Mr. Wm. J. Young, of Philadelphia, the well-known mathematical instrument maker, invented and manufactured an instrument which he named the Transit, and which was first introduced on the Columbia Railway in the year 1831. Its advantages were so evident, that its use soon became general, and it has been extensively, and we may say invariably adopted for railroad work. Improvements in details have been made from time to time, but the general design and material parts remain the same as at first.

In 1837, Mr. Samuel W. Mifflin, one of the corps above named, published a practical treatise on "Methods of Location, or Modes of Describing and Adjusting Railway Curves and Tangents, as Practiced by the Engineers of Pennsylvania;" the preface to which commences as follows: "In submitting this work to the public, I do not wish to claim for myself the exclusive authorship. A few of the first solutions were the work of my comrades on the Pennsylvania Railroad, these falling into my hands, suggested the idea of a complete series of geometric solutions applicable to all cases that might occur." The writer would observe, that although the publication of the book was not made until 1837, the several propositions which it contains, had been in use among the engineers of the Columbia Railway for several years previous, some of them dating back to 1830. Mr. Mifflin's labors in the production of this little manual, have removed many a difficulty from the path of the young engineer.

EASTERN DIVISION OF CANAL.

The eastern division of canal, commenced at Columbia, at the western terminus of the railway, and followed the eastern side of the Susquehanna river to Middletown, where it crossed the Swatara river, intersected the Union Canal owned by a private corporation, and made a connection with the river by a series of locks. It then continued up the same side of the Susquehanna river, through Harrisburg, to Duncan's Island, which was just above the mouth of the Juniata river, where it crossed the Susquehanna in a pool formed by the Clarke's Ferry dam. A carriage-road bridge was erected over the river above the dam, to which a towing path was attached, by means of which boats were taken across to the Juniata Canal. This canal, which was composed of two sections, known as the lower and upper Juniata, extended along the valley of the Juniata river to Hollidaysburg in Blair county. The entire length from Columbia to Hollidaysburg was 172 miles, of which about 16 miles were slack-water. The width was 28 feet at bottom, and 40 feet at water-line, and the depth four feet. The total rise from the basin at Columbia, to that at Hollidaysburg, was $67\frac{5}{10}$ feet. The mechanical work consisted of 21 dams, 31 aqueducts, 115 locks, 70 culverts, 201 road and farm bridges, and 21 towing-path bridges. The construction was commenced in July, 1826; portions were successively brought into use as completed; and the entire line was navigable for boats at the close of the year 1832. The total cost was $5,313,251.

The chief engineers engaged at various periods during the location and construction, were William Strickland, Samuel H. Kneass, and A. B. Warford on the Susquehanna, and De Witt Clinton, jr., Alexander C. Twining, and Edward F. Gay on the Juniata.

ALLEGHENY PORTAGE.

The Allegheny Portage Railroad, extended from the east end of the lower basin at Hollidaysburg, to the west end of the basin at Johnstown, a distance of $36\frac{7}{10}$ miles. The summit of the mountain where the railroad crossed, was $1{,}398\frac{7}{10}$ feet above the basin at Hollidaysburg, and $1{,}171\frac{6}{10}$ feet above that at Johnstown. There were ten inclined planes, five on each side of the mountain, all straight in direction, the angles of inclination of which, ranged from four degrees and nine minutes to five degrees and 51 minutes. The descent on each was regular from the top to a point 200 feet from the bottom, the last 200 feet being curved vertically, and having a descent equal to that on 100 feet of the upper portion. At the head of each plane were two stationary steam engines of from 30 to 35 horse-power each. The spaces between the planes were short, being from one-fourth of a mile to four and a quarter miles in length, with the exception of the space between planes numbers one and two, on the western slope, which had a length of $13\frac{1}{10}$ miles. The gradients ranged from a level to $26\frac{4}{10}$ feet per mile ascending, and $52\frac{8}{10}$ feet per mile descending eastward. The minimum curvature was $441\frac{7}{10}$ feet radius, or 13 degrees deflection for a chord of 100 feet; but only a small proportion of the curvature was less than $955\frac{6}{10}$ feet radius, or 6 degrees to the 100 feet.

The bridges were all of stone, the principal of which were as follows: The viaduct over the Little Conemaugh river, having a semi-circular arch of 80 feet span. That over the Ebensburg branch of the Conemaugh, having a span of 40 feet with 10 feet rise. A similar one over the mountain branch of the Conemaugh. And a viaduct of two oblique arches over the Beaver Dam branch of the Juniata river; each opening being 33 feet at right angles to the axis. In addition to these there were 68 arched culverts with spans varying from 3 to 25 feet, and 87 drains or box culverts of from 2 to 3 feet span; making a total of 159 passages for water under the railroad. About four miles from Johnstown was a tunnel 900 feet in length.

The railway superstructure on the inclined planes, was formed of timber string pieces six by eight inches, laid upon cross ties placed four feet apart, and plated with flat iron bars two and one-quarter inches wide by five-eighths of an inch thick. On the remaining portions of the road, malleable iron edge rails weighing 39½ pounds per yard, were used. These rails were secured by wrought-iron keys, or wedges, to cast-iron chairs placed upon stone blocks where the ground was firm, and upon timbers upon newly-formed embankments. The stone blocks were required to be two feet long, by twenty-one inches wide, and twelve inches deep, and were placed three feet apart between centres, firmly bedded on broken stone. The iron rails and a portion of the cast-iron chairs were obtained from Wales, costing when delivered upon the road, about seventy dollars per ton.

The grading and masonry of the road were commenced in 1831, and completed at the close of the year 1833, at which time a single track of railway was nearly ready for use; but the line was not opened for transportation until March 18th, 1834. In the month of May following, the construction of the second track was placed under contract, and prosecuted during the season, but was not entirely finished until some time in 1835; during which year, locomotive engines were placed upon the thirteen-mile level, between planes numbers one and two.

The entire cost of the road, including stationary engines, engine houses, water stations, machine shops, and depots, was $1,860,753.

The engineer corps engaged in the construction of the Portage Railroad, consisted of Sylvester Welch, chief engineer; three principal assistants—Edward Miller in charge of machinery, Solomon W. Roberts in charge of the western division, and W. Milnor Roberts of the eastern division; and four sub-assistants, Thomas Gorton, Thomas J. Power, James E. Day, and Curtis F. Dixon.

The same causes which induced the avoidance of the inclined planes upon the Columbia Railway, led to a movement for avoiding those on the Allegheny mountain, and in accordance with an act of the legislature adopted May 10th, 1850, surveys for the purpose were made during that and the following year, under the direction of Robert Fairies, civil engineer. The result was the location of a line by which all the planes were avoided, with a maximum grade of 75 feet per mile, and a tunnel of about 2,000 feet in length at the summit.

The improvement having been authorized, work on a portion of the line was commenced in 1851, and in the year following, the entire length of the road was under contract. The distance by the new line from Hollidaysburg to Johnstown was 43 miles, being about six miles in excess of the old route, portions of which were incorporated into the new work. The road-bed was graded of sufficient width for two tracks, but only one was laid from Hollidaysburg to a junction with the Pennsylvania Railroad at the south fork of the Conemaugh, about nine miles east of Johnstown. From south fork to Conemaugh a distance of seven miles, the tracks of the Pennsylvania Railroad Company were made use of. A portion of the road was brought into use in April, 1855, and the entire line was in operation during the year 1856. The amount expended upon the new line was $2,127,970.

WESTERN DIVISION OF CANAL.

The western division of canal, extended from the basin at Johnstown, along the valleys of the Conemaugh, Kiskiminetas, and Allegheny rivers, to Allegheny city, whence it was carried by an aqueduct over the Allegheny river into the city of Pittsburgh, and conducted by a tunnel through Grant's hill to the Monongahela river. The length was 105 miles, and the dimensions the same as those of the Eastern division. It had 65 locks, with a total lockage of 470 feet, 11 dams, 16 aqueducts, 89 road and farm bridges, 18 towing path bridges, and 43 culverts.

The construction was commenced in the year 1826, and completed in 1830, at a cost of $3,173,432, under the direction of James D. Harris and Alonzo Livermore engineers.

SUMMARY OF MAIN LINE.

	Miles	Cost.
Columbia Railway	81.6	$5,277,278
Eastern division of canal	172	5,313,251
Portage Railroad	36.7	1,860,753
Western division of canal	105	3,173,432
	395.3	$15,624,714
New Portage		2,127,970
Total cost		$17,752,684

DELAWARE DIVISION OF CANAL.

The Delaware division, commenced at Bristol in Bucks county, on tide-water, 18 miles above Philadelphia, and following the direction of the Delaware river, which at some points it approached very closely, terminated at Easton, where it met the canal of the Lehigh Navigation Company. The length was 59¾ miles, width at water line 40 feet, and depth 5 feet. It had 2 dams, 10 aqueducts, 28 locks, with a total rise from mid-tide to the comb of the feeder dam of 164 feet, 88 road and farm bridges, 22 towing-path bridges, 19 culverts, and a tide basin of five acres at Bristol. The construction was commenced in October 1827, and completed in October 1830, at an expenditure, of $1,454,937, under the direction of Henry G. Sargent engineer.

SUSQUEHANNA DIVISION OF CANAL.

The Susquehanna division, extended from Duncan's island near the mouth of the Juniata river, to Northumberland, a distance of 41 miles. The construction was commenced in the year 1827, under the direction of Simeon Guilford as chief engineer, and completed during 1830. The principal structures consisted of one dam, eight aqueducts, thirteen lift and guard locks, fifty-nine road and farm bridges, and eleven culverts, in additon to which were a dam and lock on Penn's creek. The total lockage was 86½ feet, and the elevation of the highest point above mean tide 418 feet. The cost was $897,160.

NORTH BRANCH DIVISION OF CANAL.

The North Branch division, commenced at Northumberland, and terminated at Lackawanna, a distance of 72½ miles, of which about four miles were slack-water. Work was commenced on this division in the year 1828, and the canal was navigable throughout in July 1834. The structures were, two dams, seven aqueducts, fourteen lift locks, one guard lock, one hundred and twenty-four road and farm bridges, five towing-path bridges, and twenty-four culverts. The total rise was 112 feet, and the highest elevation above tide 530 feet. The cost was $1,623,117.

The division was composed of two sections; one of which designated the Lower North Branch Canal, extending from Northumberland to Nanticoke 55½ miles, was constructed under the direction of Charles T. Whippo engineer; the other, known as the Wyoming line, 17 miles in length, was commenced under James Ferguson, and completed by John Bennett, engineer.

WEST BRANCH DIVISION OF CANAL.

The West Branch division, extended from the junction of the Susquehanna and North Branch divisions at Northumberland, to Queen's Run, about four miles above Dunnsburg or Lockhaven, a distance of 71$\frac{7}{10}$ miles. The lower 24 miles, known as the

Muncy line, were constructed under the direction of Francis W. Rawle engineer; and the upper portion or Lycoming line, under James D. Harris and Robert Faries engineers. The mechanical work consisted of four dams, twenty-two locks with a total lockage of 128 feet, sixteen aqueducts, one hundred and fifty-two bridges, and thirty-three culverts.

Two short branches were attached to this division; one of which, the Lewisburg side cut, about six-tenths of a mile in length, left the main line about six miles above Northumberland, and connected with the West Branch river opposite to the town of Lewisburg. It had one dam, three locks with 21 feet of lift, one bridge, and one culvert. The other or Bald Eagle side canal, commenced at the pool of the feeder dam, and extended to the Bald Eagle creek; its length was $3\frac{65}{100}$ miles, and it had one lock of 8 feet lift, and one culvert.

Construction was commenced on the Muncy line in the year 1828, and the work completed through to Lockhaven in 1834. The Tangascootack extension, $7\frac{85}{100}$ miles in length, was commenced in 1835, but only about four miles up to Queen's run, were completed and brought into use. The total amount expended between Northumberland and Queen's run, was $2,034,387.

BEAVER DIVISION OF CANAL.

The Beaver division, commenced on the Ohio river 28 miles below Pittsburgh, at the mouth of Big Beaver river, and extended up that stream and Shenango creek 30¾ miles, of which 8 miles were canal, and 22¾ miles slack-water. The structures consisted of seven dams, eighteen lift and guard locks, with 132 feet of lockage, two aqueducts, and thirteen road and farm bridges.

The construction was commenced in the year 1831, and completed in 1834, under the direction of Charles T. Whippo engineer, at an expenditure of $519,365.

FRENCH CREEK DIVISION OF CANAL.

The Franklin line of the French Creek division, commenced on the Allegheny river, near the town of Franklin, 93 miles above the mouth of Kiskiminetas river, where the Western division of canal crossed the Allegheny, and extended up French creek 25 miles to the feeder, which was also navigable, and which branched in two directions from the junction; the right branch being 8 miles in length, and the left branch 13 miles to Conneaut lake. The entire length of the line was 46 miles, of which 27½ miles were canal, and 18½ miles slack-water, making with the Conneaut lake, about 50 miles of navigation.

The mechanical work consisted of twelve dams, sixteen lift locks with a total rise of 120½ feet, five guard and outlet locks, twelve road and farm bridges, and one culvert. Construction was commenced on the feeder in the year 1827, and on the Franklin line in 1831, and the entire work was completed in 1834, at an expenditure of $817,780. James Ferguson was the engineer of the feeder, and Alonzo Livermore of the Franklin line.

All of the State canals were uniform in dimensions, namely, 28 feet wide at bottom, 40 feet at water line, and 4 feet deep, with the exception of the Delaware division which had a depth of 5 feet.

The canals and railroads thus far described, were completed and operated under the management of officers appointed by the State, until they were disposed of as hereinafter mentioned.

There were several other lines projected, which after a considerable expenditure of funds, were disposed of to other parties, or abandoned in an unfinished condition. They are described as follows:—

NORTH BRANCH EXTENSION.

An extension of the North Branch Canal from Lackawanna to the New York State line, having been authorized by the legislature, a location was made in the summer of 1836, by James D. Harris engineer, and a portion of the line placed under contract in October of that year. The work progressed under his direction until 1839, when he was succeeded by William B. Foster, Jr., who continued in charge until 1841, when operations were suspended. Work was resumed in 1849 under Mr. Foster, and urged forward to completion by him and his successor Matthew

A. Gamble, who resigned in October 1854, when William R. Maffet was appointed engineer and superintendent. A part of the line was in navigable order during 1855 and 1856, but unexpected difficulties delayed the opening of the entire route, until after it passed out of the possession of the State in 1858.

The distance from the upper end of the old North Branch division at Lackawanna, to the New York State line was 94¼ miles, following the valley of the Susquehanna to the mouth of the Chemung river, and thence along the latter to the terminus, where by means of the Junction Canal, a connection was made with the Chemung division of the New York system of canals; thereby accomplishing the object of the extension, which was to connect the improvement of the two States.

The mechanical structures, consisted of three dams, three guard locks, twenty-three lift locks with a total lockage of 188 feet, twenty-one aqueducts, ninety road and farm bridges, and forty-six culverts. The amount expended upon this line by the Commonwealth was $4,643,491. It was subsequently disposed of with the North Branch division.

GETTYSBURG EXTENSION.

The report of the canal commissioners of December 1836, refers as follows to the commencement of the Gettysburg Railroad: "The State of Maryland having passed the requisite laws, and the Baltimore and Ohio Railroad Company having consented to a satisfactory connection of their road with the Gettysburg extension of the Columbia Railway, the board caused to be located and put under contract, 22½ miles of said road, beginning at the borough of Gettysburg, and extending to the summit of the South mountain. It appears, by the report of the engineer, that this road will be embarrassed by no inclined planes. The work is deemed of great importance to Pennsylvania. The link from Gettysburg to Hagerstown, is all that it is necessary for the State to make to complete a continuous chain of railroad from Philadelphia to Pittsburg and Wheeling. A company has been chartered, and is already in active operation, to make that part which lies between the termination of the Columbia Railway at Wrightsville, and Gettysburg. The right to have transported on the Baltimore and Ohio Railroad, the persons and things passing to and from the Pennsylvania road, together with a fixed mode of charging toll thereon, is secured to this State by an act of the last legislature of Maryland, and assented to by the Baltimore and Ohio Railroad Company. Thus by the expenditure of but little more than one million of dollars, Pennsylvania will have the use of a work which will probably cost eight or ten millions more."

In explanation of this seeming liberality on the part of the State of Maryland, and the Baltimore and Ohio Railroad Company, it must be stated, that the State of Pennsylvania as an equivalent, authorized by act of legislature, the construction of outlet locks to the Pennsylvania Canal at Columbia, by means of which, the trade of the main line and the North and West Branch canals, would be enabled to pass by the Susquehanna and Tide-water Canal to Baltimore. The outlet locks were built, and the connection between the Pennsylvania state improvements and the Tide-water Canal completed; but the Baltimore and Ohio Railroad Company, changed the location of their road from the north to the south side of the Potomac river, thereby putting it out of the power of the state of Pennsylvania to make the stipulated railroad connection, and effectually defeating the object for which the construction of the Gettysburg Railroad was undertaken.

The location of the 22½ miles previously mentioned, was made by John P. Baily, engineer, and the work contracted for in October 1836. The ascent of the mountain was made with a grade of fifty feet per mile for thirteen miles, the minimum radius of curvature being 955 feet.

Mr. Baily's attention being required at other portions of the State works, he was relieved of the charge of the Gettysburg Railroad in April 1837, and Samuel W. Mifflin, at that time engineer of the railroad between York and Gettysburg, appointed to take his place. The work on the eastern slope of the mountain, progressed under Mr. Mifflin's direction until June 1838, when he resigned, and was succeeded by W. Hasell Wilson. In October of that year, eight miles of the road descending from the summit of the South mountain towards Waynesburg, were located and placed under contract. During the following winter, a survey was made from the end of the located line, to the Potomac river near Clear Spring, connecting with what was supposed to be the located line of the Baltimore and Ohio Railroad.

In March, 1839, work was suspended, and no attempt at resumption has since been made. The total amount expended on this line was $682,846.

ERIE EXTENSION.

During the summer of 1836, surveys were made by Charles T. Whippo, under instructions from the canal commissioners, for an extension of the Beaver Canal to the city of Erie, also for a railroad from Freeport by way of Butler to Newcastle.

A portion of the canal line was located, and on September 6th of that year, 45½ miles northward from the head of the Beaver division about six miles above Newcastle, were placed under contract. Another portion 14½ miles in length, extending to the terminus of the French creek feeder at the outlet of Conneaut lake, was contracted for in 1838. On these two sections forming what was designated the Shenango line, there were forty-four locks with a total lockage of 284½ feet, five dams, three aqueducts, eleven culverts, eighteen road bridges and seventy-six farm bridges. At Hartstown was a reservoir comprising over four hundred acres, and another of large extent at Conneaut lake.

The Conneaut line, extending from Conneaut lake to the harbor of Erie, was 45½ miles in length, and had seventy-one locks with a total lockage of $507\frac{7}{10}$ feet, nine culverts, fifty road and fifty-five farm bridges. Eleven and a half miles of this line were put under contract in 1838, and the remainder in 1839. The length of the extension including four miles of Conneaut lake was 109½ miles, making with the Beaver division, a total distance of 140¼ miles of canal and slackwater navigation, from the Ohio river at the mouth of the Beaver, to the harbor of Erie. The ascent from the Ohio river to the summit level at Conneaut lake, taking the bottom of the canal, was 416½ feet, and the descent thence to seven and a half feet below the surface of water at Lake Erie was 509½ feet.

" By an act of the legislature approved March 7th, 1843, entitled an act to incorporate the Erie Canal Company, it is provided; that upon the issuing of letters patent by the Governor to the said company, the Erie division of the Pennsylvania Canal, from the town of Erie to the mouth of Beaver on the Ohio river, together with the French Creek feeder, shall be vested in the corporation."

" *Provided*, That the Beaver line of said canal from Newcastle to the Ohio river, shall not be surrendered up to the said company, until the whole line from Newcastle to Erie, shall be completed and in actual use for the transportation of merchandise throughout its entire length." Other provisions were made in regard to a possible resumption of the line by the State. In accordance with the terms of this act, a company was chartered, and the portion of canal between Newcastle and Erie, delivered up on August 1st, 1843. The remaining part between Newcastle and the Ohio river, was transferred on January 1st, 1845.

The amount expended by the Commonwealth upon the Erie extension was $3,196,149, making with the expenditures upon the Beaver Canal and the French Creek feeder, for construction and repairs over and above receipts, the aggregate cost of the line surrendered to the Erie Canal Company, $4,548,906.

The Franklin line of the French Creek Division was subsequently abandoned.

WISCONISCO CANAL.

This canal extended from Wisconisco creek at the western terminus of the Lykens Valley Railroad, to the pool of Clarke's Ferry dam at Duncan's Island, a distance of 12¼ miles. It was intended to furnish an outlet for the coal of Lykens and Bear valleys. The location was made, and construction commenced under the direction of John P. Baily in the year 1838. The work passed into the charge of A. B. Warford in 1839, and was suspended in 1842 after an expenditure of $393,441. It was subsequently transferred to the Wisconisco Canal Company. The principal structures were one dam, one guard lock, six lift locks, with a total lockage of 35 feet, three aqueducts, two culverts, and eighteen bridges.

SINNEMAHONING EXTENSION.

The legislature by the act of April 14th 1838, directed the canal commissioners, to locate and put under contract, a canal or slack-water navigation from the terminus of the Tangascootack extension, along the west branch of the Susquehanna river, to the mouth of the Sinnemahoning river, a distance of about 33 miles, which was accomplished in the month of July following. The mechanical work consisted of seventeen lift locks with a total rise of 150 feet, one guard lock, one dam, five aqueducts, nineteen culverts, and thirty road and farm bridges.

This extension, and the navigable feeder 14 miles in length, from Kittaning to the western division of canal at the aqueduct across the Allegheny river near Freeport, which was placed under contract about the same time, were considered as links in a line connecting the waters of the Susquehanna and Allegheny rivers. This was a project, in regard to which great expectations had been formed, by the advocates of an uninterrupted canal route between the eastern and western parts of the State.

Benjamin Aycrigg was the principal engineer in charge of these lines, and of other improvements on the Allegheny and West Branch rivers during the year 1838. Work was suspended on both operations in 1839, the expenditures on the Sinnemahoning extension having amounted to $151,771, and on the Allegheny feeder to $31,592.

SURVEYS.

Surveys were made in 1837, by James D. Harris, for a line of canal along Penn's creek, from the Susquehanna river to New Berlin in Union county, a distance of 11¾ miles, and for a railroad between the same points.

The legislature by their act of April 1838, authorized the canal commissioners, to have surveys made for a continuous railroad from Chambersburg to Pittsburgh, without inclined planes; also for a railroad, canal, or slack-water navigation, along the Raystown branch of the Juniata river. Three parties were organized for these purposes, under the direction of Hother Hage chief engineer, and a very wide scope of country without any conditions or restrictions as to intermediate points, was allotted for examination. The results of the surveys demonstrated, that a line with favorable gradients could be obtained, by way of Cowan's Gap, Bedford, Somerset, and Laughlinstown, to the Monongahela river at Pittsburgh, a distance of about 243 miles, but the examinations were only preliminary and no location was made. The distance from Chambersburg to Philadelphia by railroads then in operation, was 158 miles.

A slack-water navigation 54 miles in length, along the Raystown branch of the Juniata, was recommended by the engineer, as the best mode of transportation for the products of that section of country.

Public interest in the establishmont of continuous railroad communication between Philadelphia and Pittsburgh, appears to have been stimulated by the results of Mr. Hage's surveys, as we find that in July 1839, the legislature directed the organization of an engineer corps on a large scale, "to make thorough examinations and surveys, with a view to form a connection between Harrisburg and Pittsburgh by means of a continuous railroad."

In accordance with the directions of the legislature, the canal commissioners appointed Charles L. Schlatter chief engineer, who immediately proceeded to the organization of three separate parties, to each of which was assigned a distinct field of operations. To one party, were allotted all the routes north of the Juniata river, classed under the head of the Northern route; to the second, the routes by the valleys of the Juniata, Conemaugh, and Black Lick, under the general head of the Middle route; and to the third the Southern route by way of Chambersburg.

The surveys on the several routes were commenced early in September, and prosecuted with vigor until stopped by the inclemency of winter. They were resumed in the following season, and as stated by the chief engineer, "the instrumental examinations and locations, upon the several routes which were selected as presenting the most favorable features for a line of railroad without inclined plane, exceeded one thousand and sixty miles.

The prominent features of the three routes were as follows: the Northern route, commenced at Harrisburg, and followed the valley of the Susquehanna to Northumberland; thence by the West Branch to the mouth of Bald Eagle creek, and by the Bald

Eagle valley and one of its tributaries, to the summit of the Allegheny mountain at Emigh's gap. Descending the western slope of the mountain, the line after crossing the Moshannon creek, followed successively for short distances, Clearfield creek, Beaver dam branch, and Chest creek, to the head waters of Black Lick, which it descended to its junction with the Conemaugh. Crossing the latter stream near Blairsville, it pursued a very direct course through Westmoreland county, to the Monongabela river at the mouth of Turtle creek, and thence along the Monongahela to Pittsburgh.

The Middle route, followed the Susquehanna river from Harrisburg to the mouth of Juniata, thence the Juniata to the junction of the little Juniata at Petersburg, and the latter stream and Sugar run, to the summit of the Allegheny mountain, which it crossed at the Sugar Run gap. From this point there was a choice of two routes; one by the Conemaugh river, making use of a part of the Portage railroad; and the other by Black Lick; both routes joining the Northern route near Blairsville, and following it as above described to Pittsburgh.

The Southern route, corresponded very closely with the one surveyed by Hother Hage in 1838, from Chambersburg, through the counties of Franklin, Bedford, Somerset, Westmoreland and Allegheny.

Various sub-routes, amounting in the aggregate to about five hundred and sixty miles, were recommended by the engineer for examination before a location should be established.

The board of canal commissioners in their review of Mr. Schlatter's report, expressed their gratification at the successful results obtained, and while admitting a preference for the Middle route, recommended, "that the surveys should be prosecuted to the conclusion, so that no doubt should rest upon the minds of our citizens, as to the best route for this great work, which must prove so conducive to the interests of the State."

No further action in the matter was however, taken by the State authorities, and when a few years later, the Pennsylvania Railroad Company was incorporated to construct a railroad from Harrisburg to Pittsburgh, the line adopted for its location, approximated very nearly in its general features to Mr. Schlatter's Middle route.

The following recapitulation will show the entire amount expended by the State, upon the several lines or divisions of the public works:

Main Line of canal and railroad,		$17,752,684
Delaware division of canal,		1,454,937
Susquehanna "		897,160
North Branch "		1,623,117
West Branch "		2,034,387
Beaver "		519,365
French Creek "		817,780
Finished lines,		$25,099,430
North Branch extension,	$4,643,491	
Gettysburg "	682,846	
Erie "	3,196,149	
Sinnemahoning "	151,771	
Wisconisco Canal,	393,441	
Delaware division improvement,	88,826	
Allegheny feeder,	31,592	
Unfinished lines,		$9,188,116
Surveys,		158,837
		$34,446,383

A report of the Auditor-General and State Treasurer, prepared for the legislature, gave the following results from the origin of the system, to the close of the financial year 1853:

Amount of revenue collected,	$25,342,020
Expended for repairs and operating expenses not included in cost of construction,	19,499,857
Amount of profit,	$5,842,163
In the same report, the amount paid for interest on loans pertaining to the public improvements, was stated at	35,157,796
Showing a loss on interest account of	$29,315,633

It will thus be seen that, in a financial aspect, the internal improvements of the State were not a success; but the amounts expended in their construction, were well repaid by the benefits resulting from their development of the resources of the Commonwealth, from the opening up of extensive sections of country which otherwise would have been shut out from a market, and from the impetus given to trade and industrial pursuits of all kinds. These objects having been to a great extent accomplished, public opinion began to manifest itself against any further increase of the State debt. A strong and growing feeling also prevailed against the ability of the Government to conduct operations on the public improvements with economy and success. Their management involved the employment of a large number of officials, and the handling of considerable sums of money, and became as will readily be understood, a powerful machine for political purposes. The taxpayers of the State finally came to the conclusion, that their interests would be promoted by transferring the control of the public works to private corporations, and they succeeded in having that policy adopted.

By an act of the legislature approved on May 16th 1857, the Governor was required within ten days after appproving the act, to make advertisement in certain prescribed manner, that the main line of the public works would be exposed to public sale in the city of Philadelphia, at a time and place to be designated by him not more than forty days after the passage of the act. By the third section of the act, the sum of seven and a half millions of dollars was designated as the minimum price, with a proviso that if the Pennsylvania Railroad Company became the purchashers, they should pay an additional sum of one and a half millions of dollars; in consideration of which, the Pennsylvania Railroad Company, and the Harrisburg, Portsmouth, Mt. Joy and Lancaster Railroad Company, should be discharged by the commonwealth forever, from the payment of all taxes upon tonnage or freight carried over the said railroads.

The board of canal commissioners, made application to the Supreme Court of the State, for an injunction to stop the sale, on the ground of the unconstitutionality of the act. After a hearing of the case, the court delivered their opinion, declaring as unconstitutional that portion of the proviso in the third section of the act, which granted special privileges to the Pennsylvania Railroad Company; but adding "that there was no legal objection to the sale of the main line, nor to the right of the Pennsylvania Railroad Company to become a competitor and a purchaser, upon equal terms with every other person or corporation." The injunction was awarded, merely to prohibit the sale upon the terms of the proviso above recited. All other parts of the act were declared constitutional, with nothing to prevent a sale to the Pennsylvania Railroad Company or any other corporation or person or persons, under the general provisions of the act.

At the time fixed by the Governor, the main line of the public works was offered for sale by an auctioneer, and struck down to the Pennsylvania Railroad Company, at the minimum price fixed in the act ($7,500,000) they being the only bidders.

On the first day of August, 1857, the main line of railroad and canal between Philadelphia and Pittsburgh, with all the appurtenances and equipment owned by the State, passed into the possession of the Pennsylvania Railroad Company. Within a year after the transfer, the old and new Portage roads over the Allegheny Mountain, were stripped of all materials of any value, which were used or otherwise disposed of by the Pennsylvania Railroad Company. The routes of the two roads are still well defined by the grading, which was generally heavy, but the roadbeds with the exception of an occasional piece used for a common road, or farmed by the owner of adjacent lands, remain unoccupied.

The Western division of canal between Johnstown and Pittsburgh, was abandoned after the completion of the Western Pennsylvania Railroad from Blairsville to Allegheny City, which followed very nearly the same route, and at some points particularly along the Allegheny River, occupied parts of the old canal bed and banks.

The Pennsylvania Railroad Company having constructed a branch railroad from Hollidaysburg eastward to Williamsburg, the portion of the Juniata Canal between those points, with the additional distance to Petersburg about 31½ miles altogether, has been abandoned. The remainder of the Eastern division from Petersburg to Columbia, is now owned and operated by the Pennsylvania Canal Company for local traffic.

The Columbia Railway, which is the only portion of the old main line now incorporated into the great thoroughfare between Philadelphia and Pittsburgh, has been to a great extent reconstructed by the Pennsylvania Railroad Company. At many points the alignment has been changed for the purpose of getting rid of objectionable curvature; the bridge masonry has been almost entirely rebuilt, and the wooden superstructure replaced in every instance by iron; considerable lengths of third and fourth tracks have been laid; engines houses and workshops have been built at the termini, and numerous passenger and freight depots erected.

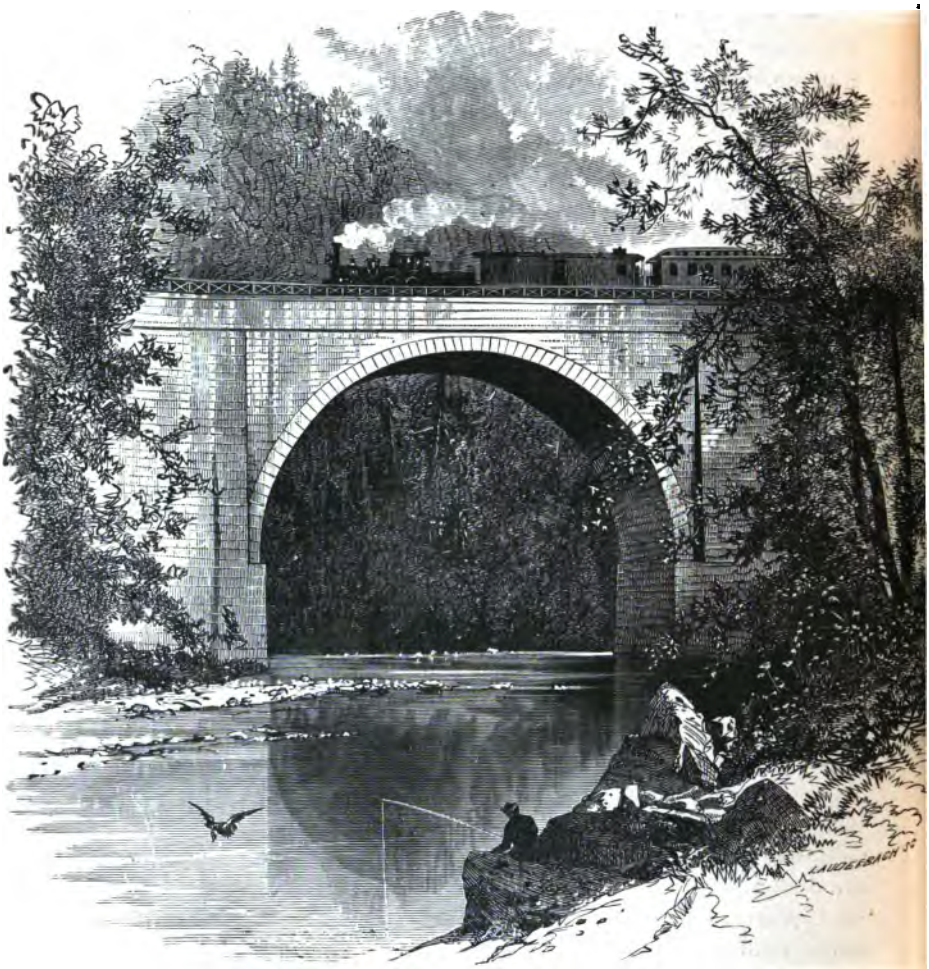
The main line having thus been disposed of, the remaining lines were not long retained in possession of the state.

The Sunbury and Erie Railroad Company (changed in 1861 to the Philadelphia and Erie Railroad Company) had undertaken the construction of a railroad from Sunbury to Erie, and had expended a considerable amount in furtherance of that object; but at the close of the year 1857, they had about exhausted their resources, and were almost at a stand. To assist them in making financial arrangements for the prosecution of their work, the completion of which was considered a matter of public interest, a bill was introduced into the legislature, providing for the sale to them of the several divisions of canal still owned by the State, under such conditions as would enable them to raise money for their railroad work. An act was passed by the legislature and approved April 21st 1858, by which the Sunbury and Erie Railroad Company were authorized to purchase from the state, the Delaware division, North Branch division, North Branch extension, West Branch division, and Susquehanna division, for the sum of $3,500,000, to be paid in five per cent. bonds of the company, secured by a mortgage upon the line of railroad between Sunbury and Erie.

The Sunbury and Erie Railroad Company, subsequently sold the several divisions of canal, to different companies organized for the purpose of operating them. The proceeds of the sales having exceeded the consideration paid by the Sunbury and Erie Railroad Company by the sum of $375,000, seventy-five per cent. of this amount was paid over in compliance with the conditions of the act of sale, making the entire amount of the payment to the state $3,781,250.

Some changes in the ownership have since taken place, and the several lines are now owned as follows: The canal from Bristol to Easton, remains in possession of the Delaware Division Canal Company, to whom it was sold by the Sunbury and Erie Railroad Company. The Pennsylvania Canal Company own and operate, the Canal from Columbia along the Susquehanna and North Branch rivers to Wilkesbarre; the Juniata Canal from the junction at Duncan's Island to Petersburg; the West Branch Canal from Northumberland to Lockhaven; and the Wisconisco Canal. The canal from Wilkesbarre to the New York State Line, has passed into the possession of the Pennsylvania and New York Canal and Railroad Company, who have constructed and now operate a railroad along the entire length. The canal is maintained for about twelve miles from Wilkesbarre to Lackawanna, as a feeder to the canal below Wilkesbarre; but the portion from Lackawanna to the New York Line 94¼ miles in length, which was known as the North Branch extension, has been entirely abandoned for purposes of navigation.

The transfer of the canals to the Sunbury and Erie Railroad Company, terminated the ownership and management of the public works by the state. Errors were without doubt committed in the design as well as the execution of the state internal improvements, but in reviewing their history, allowance should be made for the times and circumstances under which they were projected and constructed. They compared favorably with contemporaneous works in any part of the world, and it is neither fair nor just to criticise them by the superior light of the present day.


LAUDERBACH SC

REMINISCENCES OF THE FIRST RAILROAD OVER THE ALLEGHENY MOUNTAIN.

READ BEFORE THE HISTORICAL SOCIETY OF PENNSYLVANIA, APRIL 8TH, 1878.

BY SOLOMON W. ROBERTS, CIVIL ENGINEER.

THE following reminiscences of the First Railroad over the Allegheny Mountain, have been prepared at the request of the Council of the Historical Society of Pennsylvania.

They relate to the Portage Railroad; the building of which was begun by the State in the year 1831; which was opened for use as a public highway in 1834; and was an important thoroughfare for about twenty years, until it was superseded by the opening of a railroad without inclined planes.

As the Portage Railroad was considered for years to be a great triumph of civil engineering, and as it has ceased to exist, I embrace this opportunity to give my recollections of its construction, having been employed upon the line, in the service of the State.

The undertaking of an extensive system of internal improvements at the expense of the Commonwealth, was an event of no small importance in the history of Pennsylvania. An account of this great enterprise, which increased the State debt to about forty millions of dollars, has never been adequately written. The high hopes with which the work was begun; the large premiums at which the five per cent. loans of the State were for a time sold; the great revulsion of feeling, and the fall of prices, which caused the loans to sell at one time for about thirty-three cents on the dollar; the subsequent sale of the public works to corporations, and the complete recovery of the State credit, are facts well worthy of remembrance.

The geographical position of Pennsylvania, so often called "the Keystone State," is peculiar and remarkable. Washed on its southeastern border by the Atlantic tides, it extends on the northwest to the shore of Lake Erie, and includes, in Allegheny County, the head of the Ohio River. Various lines of internal improvement were proposed in the early history of Pennsylvania, but the rugged topography of much of its territory delayed their execution.

The level character of the country between Albany and Buffalo, enabled New York to construct the Erie Canal, which was opened for use in October, 1825. This stimulated similar action on the part of the legislature of this State, and the Pennsylvania Canal was begun on the 4th of July, 1826.

In the following year I entered the service of the Lehigh Coal and Navigation Company. A native of Philadelphia, and educated in Friends' Academy, I witnessed the construction and opening of the Mauch Chunk Railroad in 1827, and of the Lehigh Canal, which was opened from Mauch Chunk to Easton in 1829, having been employed as a rodman and leveller on fifteen miles of the canal. For more than two years I lived in the house of my uncle, Josiah White, who was then acting manager of that company, and had the advantage of receiving instruction from that able, practical engineer; and, in the engineering corps on the canal, I received scientific and technical training under those masters of the profession, Canvass White and Sylvester Welch, who had been employed on the Erie Canal.

When the work on the Lehigh was done, in the autumn of 1829, Sylvester Welch was employed by the State of Pennsylvania as principal engineer of the Western Division of the Pennsylvania Canal, and removed to Blairsville, on the Conemaugh, to which place I accompanied him. The canal was then nearly completed from Pittsburgh to Blairsville, and was in progress from Blairsville to Johnstown. Much of the work was badly done, and was not strong enough to withstand the occasional floods to which it was exposed. The Canal Commissioners were politicians, there was great competition for contracts, and work contracted for at low prices often failed to endure the strains t which it was subjected; the laws of nature having no respect fo political parties. We struggled on with the work, and the cana was opened to Johnstown, at the western base of the Allegheny Mountain, in December, 1830. On my division, there was an aqueduct across the Conemaugh River at Lockport, having five arches, each of sixty feet span, built of cut stone.

My intimate friend and colleague in this arduous and thankless service was the late Edward Miller, civil engineer, afterwards so well known for his great intelligence, and for his high character as a Christian gentleman. The pay that we received from the State was two dollars per day, for the time actually employed, and we paid our own expenses.

The canal being done from Pittsburgh to Johnstown, I returned to my father's house in Philadelphia, on the 23d of January, 1831, far from being pleased with the general results of my experience on the canal in the valley of the Conemaugh.

At that time there was much discussion as to the best mode of crossing the Allegheny Mountain, so as to form a connection between the canals on its eastern and western sides.

Some surveys had been made for a continuous canal, both by the Juniata route and by the West Branch of the Susquehanna; but the natural obstacles were too great, and the scheme was given up. Several lines for a railroad had also been run, and inclined planes of different kinds had been proposed.

On the 21st of March, 1831, the law was passed authorizing the Board of Canal Commissioners to commence the construction of a Portage Railroad over the Allegheny Mountain. The Board appointed Sylvester Welch, the principal engineer of the western division of the Pennsylvania Canal, to the same position in the building of the Portage Railroad, and he nominated me as his assistant. Mr. Welch was an elder brother of Ashbel Welch, the distinguished civil engineer of New Jersey. Sylvester Welch was a man of great ability and integrity, and of untiring industry, as I, who was one of his assistants for more than eight years, can testify. At his request I joined him at Blairsville, and on the 5th of April, by a resolution of the Board of Canal Commissioners, I was appointed to my position, being then in the twentieth year of my age.

On the 8th of April, 1831, just 47 years ago, we began our explorations near the summit of the mountain. The weather was cold, stormy, and unfavorable; there was much snow on the mountain; and I remember particularly that on the evening of the first day, the wind was so high as to blow heavy pieces of bark from the bodies of dead hemlock trees.

On the 12th of April, our party of sixteen persons went into camp near the head of the mountain branch of the Conemaugh, and began to locate the railroad. We had tents owned by the State, and four of us slept on buffalo robes, in what had been used as a surgeon's tent; and to my surprise I did not take cold. It had been intended that another engineer, older than myself, should lead the locating party; but his health failed before the work was begun, and he had to retire. The country was very rough, and the running of the line much obstructed by fallen timber.

The general character of the country had been ascertained from the results of former surveys, made by Mr. Moncure Robinson, Colonel Long, and other engineers. It was known that the distance over the Allegheny Mountain, from Hollidaysburg to Johnstown, was about thirty-six miles, and that the summit at Blair's Gap, was about 1,400 feet above Hollidaysburg, and 1,200 feet above Johnstown. The eastern slope of the mountain is much steeper than the western. The slates and sandstones of the bituminous coal measures dip into the mountain on its eastern slope, and show the broken ends of the strata, as if an immense wedge had been driven, in a northwesterly direction, under that part of the earth's crust. At the head of one of the inclined planes on the eastern slope, a well was bored 712 feet deep, without finding water. The western slope of the mountain is comparatively gentle, and the stratification flattens out as it approaches Johnstown.

Modern railroads were in their infancy when this work was begun, and the powerful locomotives that now draw heavy loads up high grades had no existence. It was in October, 1829, about eighteen months before, that the little engine, called "the Rocket," the first one built on the modern plan, was tried on the Liverpool and Manchester Railroad. The combination of the tubular boiler with the blast-pipe in the chimney was the cause of its success.

The general design for the Portage Railroad was this: The principal part of the elevation was to be overcome by inclined planes, which were to be straight in plan and profile; to be on average somewhat less than half a mile long; and to have an angle of elevation of about five degrees, or about the same as moderately steep hills on turnpike roads; so that the average height overcome by each plane might be about 200 feet. These planes were to be worked by stationary steam engines and endless ropes.

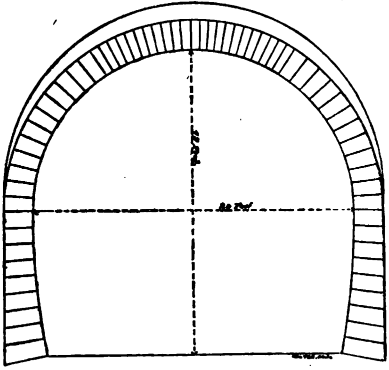
As ultimately constructed there were ten inclined planes, five on each side of the mountain; and their whole length was four miles and four-tenths, with an aggregate elevation of 2,007 feet. Their angles of inclination ranged from four degrees and nine minutes to five degrees and fifty-one minutes. The railroad between the planes was located with very moderate grades, and the minimum radius of curvature was about 442 feet, but only a small proportion of the curvature had a less radius than 955 feet. The gauge, or width of the track, was four feet nine inches.

In locating the line, our levelling instruments were good, as perfect levelling had been required on the canals, where water tested the work; but our instruments for running curves were poor, and the work was mostly done with a surveyor's compass. At that time the importance of straightness on a railroad was not adequately appreciated.

When the weather became warmer we were annoyed by multitudes of gnats, and resorted to the smoke of burning leaves to mitigate the evil. We also tried greasing our faces to keep the insects from biting them. It occurred to me that this might be one of the reasons why Indians often paint their faces.

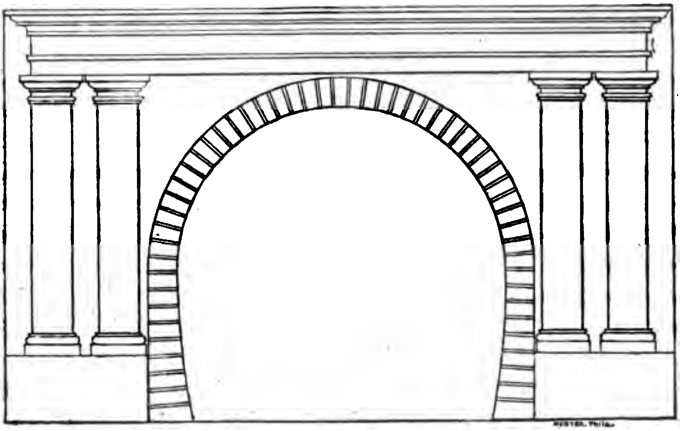
Rattlesnakes were numerous and of course dangerous, but none of us were bitten by them. They were usually sluggish reptiles, and will let men alone if they are not trodden on or attacked. They also give warning with their rattles before they strike. Our axemen made a collection of live rattlesnakes, and kept them in a box. They were easily caught by an expert hand. To the end of a stick about four feet long, a short piece of strong twine was tied so as to form a slip knot. The snake when defending itself would lie partly coiled on the ground, or on a rock, with the rattles on its tail at the outside of the coil, and its head upraised in the middle. The man approaching with the stick would slip the loop of the twine over the snake's head, and round its neck; and, by giving a little jerk, would draw the slip knot tight, and lift the snake from the ground. The snake would then writhe in vain, and would be powerless to strike. To carry it to camp, it was put into a tube made of the bark of a sapling, or small tree, peeled off for the purpose, which was readily done by an expert woodman. Catching snakes was the amusement of our men, and eating maple-sugar was our luxury. I remember that George Wolf, then Governor of Pennsylvania, visited our camp while we had the box of snakes.

Portage Railroad Tunnel. 1832.



Section of the Tunnel Arch. Span 20 feet.

Tunnel on the Allegheny Portage Railroad. First Railroad Tunnel in America. 1832.



Façade of the Tunnel. Span, 20 feet.

When we reached the Horseshoe-bend of the Conemaugh, about eight miles from Johnstown, I was in charge of the locating party. The line was made to cross the stream, and cut across the bend, so as to save distance, which made a high bridge necessary. The Horseshoe-bend, or Conemaugh viaduct, is still standing, and is used by the Pennsylvania Railroad Company as a part of its main line; and it is, I believe, almost the only structure of the old Portage Railroad now in use. It is a substantial and imposing piece of masonry, about seventy-feet high, and with a semi-circular arch of eighty feet span. The chief engineer had prepared a plan for a bridge of two arches, each of fifty feet span, but afterwards adopted the plan of the present structure. It was designed, and its erection superintended, by me, and the work was done by an honest Scotch stone-mason, named John Durno, who was afterwards killed by falling from another high bridge. The arch is three and a half feet thick at the springing line, and three feet at the crown; the arch stones are of light-colored sandstone, and the backing of silicious limestone, found near the spot. The sandstone was split from the erratic blocks, often of great size, which were found lying in the woods, on the surface of the ground. The contract price for the masonry was $4.20 per perch of twenty-five cubic feet, and the work was remarkably well done. The face stones were laid in mortar made from the silicious limestone, without the addition of any sand.

The cost of the viaduct was about fifty-five thousand dollars, and by building it a lateral bend of about two miles was avoided. The embankment at the end of the viaduct was 64 feet high. Since that work was done, iron bridges have taken the place of such structures. At the staple bend of the Conemaugh, four miles from Johnstown, a tunnel was made through a spur of the Allegheny, near which the stream makes a bend of two miles and a half. The length of the tunnel was 901 feet, and it was 20 feet wide, and 19 feet high within the arch; 150 feet at each end being arched with cut stone. Its cost was about $37,500. This was the first railroad tunnel in the United States. Inclined plane No. 1, being the plane nearest to Johnstown, was located at the western end of the tunnel. The western terminus of the Portage Railroad, at the canal basin at Johnstown, 21 miles from the starting point, was located on the 14th of May.

Johnstown, in Cambria country, is now a large town, and the seat of the great Cambria Iron Works. When I first saw the place it was a very quiet village, with tall elder bushes growing in the streets. It had been at first called Conemaugh, and I remember to have seen the original plan of the place, with its title marked: "The town of Conemaugh, the only port for boating on the western waters, east of the Laurel Hill." It had been practicable, at times of high water, to run rafts and small flat boats from there to Pittsburgh.

W. Milnor Roberts joined the engineer corps in the month of May as principal assistant, and located the eastern portion of the Portage Railroad, from the point where we began, over the summit of the Allegheny mountain, and down to Hollidaysburg, a distance of about 16 miles; which included the steep eastern slope of the mountain and most of the inclined planes. He has since distinguished himself as the engineer of many important works, and continues to be one of my most intimate friends, as he has been since we were together in the engineer corps on the Lehigh in 1827.

Proposals from contractors having been invited, the grading and masonry of the twenty-six miles, from the summit of the mountain to Johnstown, were contracted for at Ebensburg, the county seat of Cambria county, on the 25th of May, and the work on the eastern slope of the mountain, at Hollidaysburg, on the 29th of July, 1831. It was determined to grade the road at once for a double track, and to build all the bridges and culverts of stone. There was no wooden bridge upon the line. In the case of one small bridge of two spans, which had to be built at an oblique angle, I proposed an iron superstructure, but the plan was not approved.

The principal office was established at Ebensburg, although it was several miles from the railroad, because it was on the turnpike, and readily accessible. Before our office windows the Conestoga wagons, loaded with emigrants, with their baggage and furniture, slowly wended their way to the west.

We had to travel on foot along the line of the work, and very bad travelling it was for a long time. A large part of the line ran through a forest of heavy spruce or hemlock timber, many of the trees being over 100 feet high; through this a space, 120 feet wide, was cleared, which was difficult work. Immense fires were made, but the green timber did not burn well, and many of the trees were rolled down the mountain slopes and left to decay.

In looking back at the location that was thus made about forty-seven years ago, it appears to me that it was about as well done as could be expected, under the circumstances as they then existed. Railroad construction was a new business, and much had to be learned from actual trial; but it was known at the time, that the location was too much hurried, which arose from the great impatience of the public. A good deal of curvature might have been saved by a careful revision of the line; but the reduction of the height of the summit by a tunnel, as has since been done, the Legislature had refused to permit.

After the grading and masonry of the Portage Railroad were put under contract the line was divided—the western half being in my charge, and the eastern in charge of my friend, W. Milnor Roberts. The work was pushed forward with energy, a force of about two thousand men being at one time employed upon it.

Whilst our office was in Ebensburg, which was for about a year, the most noted person in the neighborhood was the Rev. Dr. Demetrius Augustine Gallitzen, whom I well remember. The summit station on the Pennsylvania Railroad is named after him. He called himself parish priest of Loretto and Vicar General. He was a Russian nobleman, born in 1770, and he left the Greek Church and became a zealous Roman Catholic missionary. He founded the town of Loretto, near Ebensburg, and died there in 1840. He is believed to have expended about $150,000 at that place; but, having been deprived of his estate in Russia, he became poor. He was a small man, of an olive complexion, with very bright eyes, and I considered him to be the most perfect example of a religious enthusiast that I had ever seen. He was deservedly held in very high esteem for his self-denying earnestness. He spent much money in building a church at Loretto, and tried hard to make the rough people on the mountain behave as he wished when they visited it. The country was very poor, and he became involved in debt, which troubled him much. It was currently reported, and I believe it to be true, that he had made a vow that he would not ride on horseback or in a carriage until his debts were paid, so that, when his services were needed at a distance from home, he was sometimes hauled on a sled.

In 1831, my friend, Edward Miller, went to England to obtain the most recent information on the subject of railroads, and he returned about the close of that year. He was soon after appointed principal assistant engineer in the service of the State, and was given the charge of the machinery of the inclined planes of the Portage Railroad.

The machinery was designed by him, and it worked well. At the head of each plane were two engines, of about thirty-five horse-power each; and each engine had two horizontal cylinders, the pistons of which were connected with cranks at right angles to each other, which gave motion to the large grooved wheels, around which the endless rope passed, and by which the rope was put in motion. The engines were built in Pittsburgh, and could be started and stopped very quickly. One engine only was used at a time, but two were provided, for the greater security. Hemp ropes were at first used, and gave much trouble, as they varied greatly in length with changes in the weather, although sliding carriages were prepared to keep them stretched without too much strain; but wire ropes were afterwards substituted, and were a great improvement.

The laying of the first track and turnouts, with a double track on the inclined planes, was contracted for on the 11th of April, 1832. The rails used weighed about forty pounds per lineal yard, and they were rolled in Great Britain. The hauling of them in wagons from Huntingdon, on the Juniata, was a laborious work. The rails were supported by cast-iron chairs, weighing about thirteen pounds each—the chairs being placed three feet apart from centre to centre, with a wrought-iron wedge in each chair. In most cases these chairs rested upon, and were bolted to, blocks of sandstone, containing three and a half cubic feet each, and imbedded in broken stone. These stone blocks were required to be 2 feet long, 21 inches wide and 12 inches deep. They cost about 53 cents each. On high embankments a timber foundation was used, with cross-ties and mud sills, which stood much better than the stone blocks. On the inclined planes, which were to be worked by means of ropes, flat bar-rails were laid upon string-pieces of timber.

Great care was taken in the drainage of the road-bed, and a large number of culverts and drains were built, there being 159 passages for water under the railroad. It was found, by experience, that the track must be tied across with cross-ties, or it could not be kept from spreading, and many such ties were put in between the stone blocks. The attempt to construct a permanent railroad track, containing no perishable material, was, in this case, a failure. We were striving to build a great public work to endure for generations, and, as it turned out, it was superseded by something better in about twenty years.

On the 26th of November, 1833, about two years and a half from the beginning of the work, the first car passed over the road, carrying a committee from Philadelphia, among whom were Josiah White and Thomas P. Hoopes, representing the Board of Trade. They were returning from Ohio, where they had been inspecting the proposed lines for connecting the Pennsylvania and Ohio canals.

On the 18th of March, 1834, when canal navigation opened, the Portage Railroad was opened for use as a public highway, the State furnishing the motive power on the inclined planes only; and it continued in use until the end of the year, when the canals were closed for the winter. The railroad was again opened on the 20th of March, 1835; shortly after which the second track was completed.

The experiment of working the road as a public highway was very unsatisfactory. Individuals and firms employed their own drivers, with their own horses and cars. The cars were small, had four wheels, and each car would carry about 7,000 pounds of freight. Usually four cars made a train, and that number could be taken up, and as many let down an inclined plane, at one time, and from six to ten such trips could be made in an hour. The drivers were a rough set of fellows, and sometimes very stubborn and unmanageable It was not practicable to make them work by a time-table, and the officers of the railroad had no power to discharge them. My memory recalls the case of one fellow, who would not go backward, and could not go forward, and so obstructed the road for a considerable time. It resembled the case of two wild wagoners of the Alleghenies, meeting in a narrow mountain pass, and both refusing to give way. Our nominal remedy was to have the man arrested and taken before a magistrate, perhaps many miles off, to have him fined according to the law, a copy of which I used to carry in my pocket.

When the road had but a single track between the turnouts, a large post, called a centre post, was set up half-way between two turnouts, and the rule was made that when two drivers met on the single track, with their cars, the one that had gone beyond the centre post had the right to go on, and the other that had not reached it must go back to the turnout which he had left. The road was, in many places, very crooked, and a man could not see far ahead. The way the rule worked was this: When a man left a turnout he would drive very slowly, fearing that he might have to turn back; and, as he approached the centre post, he would drive faster and faster, to try to get beyond it, and thus to drive back any cars that he might meet, and in this way cars have been driven together, and a man killed by being crushed between them. We had no electric telegraphs in those days.

The evils of this system were so great that I resolved that, for one, I would not continue to be responsible for its administration; but to get it changed was no easy matter, as it required an act of the Legislature. The State government was Democratic, and this was considered to be the popular way to work a railroad, every man for himself. The opposition party in the Legislature was led by a very able man, the late Thaddeus Stevens, of Lancaster county: and they were opposed to increasing the power and patronage of the Democratic Board of Canal Commissioners, which would be done if locomotives were bought and all the motive power furnished by the State. I went to Harrisburg, and obtained an introduction to Mr. Stevens. I tried to do my best to explain the matter to him, and it was a great satisfaction to me to find that he allowed the bill to pass without opposing it. The feeling of the people living on and near the lines of the two railroads owned by the State—the Portage, and the Philadelphia and Columbia—was very strong against the measure, for a reason which the following anecdote will show:

Whilst I was advocating the change I came to Philadelphia, and then returned to Harrisburg. On my return, I was riding in a horse-car on the Columbia Railroad, near Downingtown, which was divided into small compartments, somewhat like the interior of an old-fashioned stage coach. Two gentlemen were sitting opposite to me who were members of the Legislature from Chester county, one being a Senator. The car stopped, and a man spoke to my travelling companions, saying that he hoped that they would oppose the bill to authorize the Canal Commissioners to put locomotives on the road and control the motive power. The Senator said that it should never be done with his consent. Thereupon, as the car drove on, I proceeded to argue the matter, but with poor success; the reply being, that the people were taxed to make the railroad, and that the farmers along the line should have the right to drive their own horses and cars on the railroad, as they did their wagons on the Lancaster turnpike, to go to market in Philadelphia; and that, if they were not permitted to do it, the railroad would be a nuisance to the people of Lancaster and Chester counties. It required time to overcome this feeling; and, in 1834, that good man and excellent mechanic, M. W. Baldwin, of Philadelphia, built three locomotives for use on the Philadelphia and Columbia Railroad.

The law having been passed, locomotives were bought, and the State began to furnish motive power on the grade lines between the planes on the Portage Railroad. The first locomotive used on the mountain was called the "Boston," from its having been built in that city, in 1834. It was a light engine with one pair of driving-wheels, which were made of wood, with iron hubs and tires. The front end of the frame rested on a truck, having very elastic steel springs. The fuel used was wood, and the engine ran readily around short curves, and although its power was not great, the machine worked well, and gave satisfaction. It ran on what was called the long level, thirteen miles in length, between planes numbers one and two, and it did not pass over the planes.

The number of locomotives was gradually increased, and that of horses diminished, and on the 11th of May, 1835, the State began to furnish the whole motive power. In that year I had the charge of the working of the Allegheny Portage Railroad, and acted as superintendent of motive power, although called principal assistant engineer.

In October, 1835, Joseph Ritner was elected Governor of Pennsylvania, having been nominated by the Anti-Masonic party; and with his inauguration the control of the State government passed out of the hands of the Democratic party, which had long held it. At that time the feeling against secret societies was very strong, and to be connected with them was very unpopular. It is remarkable that such a change should have taken place in this respect, as secret societies are now so numerous, and their membership so very large; which seems to me to be a curious instance of the strange fluctuations of popular feeling.

The Portage Railroad was a great thoroughfare in 1835; and towards the close of the year Joseph Ritner passed over it on his way to Harrisburg as Governor-elect. He was attended by Joseph Lawrence, of Washington County, who was his confidential adviser. In the same train were Henry Clay and Felix Grundy, on their way to Washington, for the opening of Congress. There was a large party, and we dined together on the summit of the mountain. Joseph Ritner sat at the head of the table, with Henry Clay at his right hand. I remember saying that I had both masonry and anti-masonry entrusted to my care. After dinner I walked down one of the inclined planes with Joseph Lawrence, and was gratified at being told by him, that the new administration wished me to remain in charge of the railroad; but I had already concluded to resign, and to sail for Liverpool as inspector of the manufacture of railroad iron, in South Wales, for the Reading and other railroads. I had taken no active part in politics, and was weary of the service of the State. The highest pay received by me had been four dollars per day, paying all my own expenses, and carefully abstaining from all speculative interests. It is true that living was cheap; in the best hotel in Johnstown, with a good table, fuel, and light, the price of board was only $2.62½ per week. We had venison and wild turkeys in season. Venison was sometimes as low as three cents per pound, and bituminous coal for domestic use cost, I think, about one dollar per ton. Clothing was, however, comparatively dear, and its wear and tear on the mountain was great; besides which it cost a good deal to keep a saddle horse.

My experience in the State service has convinced me that our form of government is badly adapted to the successful management of public works. Civil service reform might make some improvement, but so long as the tenure of office depends upon frequently recurring popular elections, and the nominations are made by majorities in a party caucus, other considerations than those of honesty and fitness will very often determine the result. For the proper management of a railroad, strict discipline is necessary, and the power of discharging employees is needed to insure prompt obedience. In the service of a corporation this is understood, but in that of the State other considerations are apt to interfere.

It is my desire to record my belief, that James Clarke, the President of the Board of Canal Commissioners, was a man of good intentions, and of upright character, who occupied a very difficult position. His home was in Western Pennsylvania, and I knew him well. The Secretary of the Board was Francis R. Shunk, who was afterwards Governor of the State. He was noted for his quaint humor, was an admirable penman, and for a long time Clerk of the House at Harrisburg.

In the official history of the Pennsylvania Railroad, published by the Passenger Department of that Company in 1875, it is stated that "The Portage Railroad over the Allegheny Mountain was, during all the time it remained in operation, one of the wonders of America."

In 1838 was published in London a book called "A Sketch of the Civil Engineering of North America," by David Stevenson, civil engineer. The author was a son of the distinguished engineer of the Bell Rock Lighthouse. In his sixth chapter, when speaking of the Portage Railroad, he says that America "now numbers among its many wonderful artificial lines of communication, a mountain railway, which, in boldness of design, and difficulty of execution, I can compare to no modern work I have ever seen, excepting perhaps the passes of the Simplon, and Mont Cenis, in Sardinia; but even these remarkable passes, viewed as engineering works, did not strike me as being more wonderful than the Allegheny Railway in the United States." In another part of the book, he gives an account of his passage over the road.

Michel Chevalier, the distinguished French engineer and political economist, visited the railroad, and gave a description of it in his book on the public works of the United States, which was published in Paris in 1840. He is now a leader in the project for a railway tunnel under the sea from France to England.

One thing that was considered to be a great curiosity, was the carriage of canal boats over the mountain, which was done to a considerable extent. The road being, as its name implied, a Portage Railroad, a transhipment of some sort was required at both ends of the line, which caused expense and delay. Different firms, engaged in the transportation business, tried different plans to diminish the evil. One plan was the use of boats built in sections, and carried on trucks over the railroad. Another mode of carrying freight, was in cars having moveable bodies, which could be lifted off the wheels and transferred to canal boats fitted to receive them. The wear and tear of the sectional boats, and moveable car bodies, and the amount of dead weight that had to be carried, were found to be serious objections to both these plans.

For the prevention of accidents, safety cars were used upon the inclined planes. They were devised by Mr. Welch, the chief engineer, and they worked well. The cars were attached to the endless ropes by small ones called stopper-ropes. In case of the failure of any of the fastenings, or the breaking or giving way of a splice in the main rope, the safety car prevented any serious accident, by acting as a brake-shoe or drag, so as to stop the cars and prevent thom from running down the plane.

Thus the communication was kept up between Philadelphia and Pittsburgh until the time came for something better to be provided. The time required for passenger cars to pass over the road was reduced to about four hours. Many distinguished persons visited the line; the travel was very safe, and the business of 1835 amounted to about fifty thousand tons of freight, and twenty thousand passengers.

The Portage Railroad crossed the Allegheny Mountain at Blair's gap, a point nearly due east from Pittsburgh; and the excavation or cut made to reduce the summit was only about twelve feet deep, the natural summit being somewhat flat and wet. This summit, as ascertained by recent railroad surveys, was 2,322 feet above mean tide, or 161 feet higher than Gallitzin Station on the Pennsylvania Railroad, which is at the western end of the summit tunnel, at Sugar Run Gap, about two miles from Blair's Gap.

There were eleven levels, so called, or rather grade lines, and ten inclined planes on the Portage; the whole length of the road being 36.69 miles. The planes were numbered eastwardly from Johnstown, and the ascent from that place to the summit was 1,171.58 feet in 26.59 miles, and the descent from the summit to Hollidaysburg was 1,398.71 feet in 10.10 miles.

The planes were all straight, and their lengths and elevations are given in the note at the conclusion of the paper.

The descent on each plane was regular from the top to a point 200 feet from the bottom; the last 200 feet having a gradually diminishing inclination, equal to that of 100 feet of the upper portion. Part of the track, generally 300 feet long, adjoining the head and foot of each plane, was made exactly level. The object of this was to facilitate the handling of the cars.

The cost of the road at the close of the year 1835 was $1,634,357.69, at the contract prices. This did not include office expenses, engineering, or some extra allowances made to contractors, in a few instances, by the legislature, after the work was completed; nor did it include the cost of locomotives and cars. The cost of the rails for the second track, imported from Great Britain, was $48,51 per ton, when landed in Philadelphia. Acting for the State, I audited the accounts of the importers at the time. Many of the final estimates of the work were made out by me, but I will not encumber this paper with their details.

I may here mention the fact that in 1851 the State began the construction of a road to avoid the inclined planes, with a maximum grade of 75 feet per mile, and a summit tunnel about 2,000 feet long. Parts of the old line were used, and the road was lengthened about six miles. A single track was laid down, and was in use in 1856; but in the following year the whole work, as a part of the main line, was sold by the State to the Pennsylvania Railroad Company.

Antes Snyder, the youngest son of Governor Simon Snyder, of Pennsylvania, had been inspector of railroad iron in Wales, for the State. He was an engineer of good abilities and of excellent character, and a graduate of the West Point Military Academy. After his return from Wales, he was employed in the State service in Western Pennsylvania. He was offered an engagement to go abroad again, to inspect rails for the Reading Railroad, and other lines, but was unwilling to accept it, so I took his place. He was afterwards in the service of the Philadelphia and Reading Railroad Company on the Lebanon Valley line. He has been dead for some years, and it gives me pleasure to record my high respect for his memory, and for the Christian graces that adorned his character. As the State works were not directly profitable, it has been too much the fashion to assume that the management was utterly corrupt and bad. That such was the case in many instances cannot be denied, but there were many bright exceptions.

Having retired from my position on the Portage Railroad in January, 1836, I sailed soon after from New York for Liverpool. To show the great changes which have occurred in travelling since then, I may mention that, on the 14th of February, 1836, I left Philadelphia, at 5 P. M., and was fourteen hours going to New York, with the great Southern mail, although the sleighing was good. We rode in an open sled, or box on runners, and the four passengers sat on the mail bags. The fare from Philadelphia to New York was six dollars. It is now two dollars and a half, and the time is reduced to less than two hours and a half, being less than one-fifth of the time, and less than one-half of the price. My recollection is that we rode fourteen miles in a railroad car, from Elizabethtown to Jersey City.

Having remained abroad until October, 1837, I examined many public works, and superintended the manufacture of a large amount of railroad iron, and railroad equipments. At the time of my going abroad, anthracite coal was nowhere used for smelting iron-ore; but in May, 1837, I saw the problem successfully solved, by means of the hot-blast, by the late George Crane, of the Yniscedwin Iron Works, near Swansea, in South Wales. About the same time, at Bristol, England, I walked over the keel of the steamship Great Western, which had been laid not long before. Her success as a transatlantic steamer was then a question keenly contested, but it turned out to be complete. The length of my return voyage from Liverpool to Philadelphia, in a packet ship, was forty-one days.

The competition which existed between Philadelphia, New York, and Baltimore, for the trade of the West, led to the passage of an Act to incorporate the Pennsylvania Railroad Company, on the 13th of April, 1846; but the conditions contained in the Act were so stringent that the Charter was not issued by the Governor until the 25th of February, 1847. A joint special committee of the City Councils of Philadelphia made a report in July, 1846, recommending a subscription to the stock on the part of the city. The committee submitted letters on the subject from a number of engineers, which were printed with the report. In one of these letters, written by me, I urged the adoption of the Juniata route, and the use of the Portage Railroad, temporarily, as part of the line. The Charter, however, did not authorize the use of the Portage Railroad, as the Legislature was afraid of the competition of the Pennsylvania Railroad with the main line of the public works. There was also a tonnage tax imposed, to protect the business of the main line during the season of canal navigation, which was at the rate of five mills, or half a cent, per ton per mile, between the 10th of March and the 1st ot December in every year, but the railroad was to be free from the tonnage tax in what was considered to be the winter season. Although this tax was modified, it was not abolished until after the purchase of the main line by the Pennsylvania Railroad Company.

On the organization of the Pennsylvania Railroad Company in 1847, Samuel V. Merrick was chosen President; John Edgar Thomson, chief engineer; William B. Foster, Jr., associate engineer of the eastern division; and Edward Miller, associate engineer of the western division. These gentlemen, so eminently fitted for their positions, as I know from personal knowledge, they having been my intimate friends, are all dead.

In my opinion the location of the Pennsylvania Railroad deserves great praise; and, as now constructed, it is an admirable road. It has become the main artery of the trade and travel of the Commonwealth, and the population of Philadelphia is about three times as great as when it was begun.

On the 17th of September, 1850, the Pennsylvania Railroad was opened from Harrisburg to a point of connection with the Portage Railroad at Duncansville, near Hollidaysburg, portions of the line having been opened previously. About that time, Thomas A. Scott, who is now the distinguished President of the

Pennsylvania Railroad Company, entered the service of the company as station agent at Duncansville, where he had charge of the transfer of the cars between the road of the company and that of the State. He was soon after transferred to the western division as its superintendent, where he distinguished himself by his remarkable energy, and great executive ability.

On the 15th of February, 1854, the mountain division of the Pennsylvania Railroad was opened for use, with a summit tunnel and no inclined planes, and the company ceased to make use of the Portage Railroad. There had been much difficulty in obtaining the legislation to authorize the use of the Portage Railroad by the company. The original act of incorporation, passed in 1846, was very defective, and the efforts made to amend it in the following year were not successful. The necessary legislation was not obtained until 1848. In that year I was a member of the House of Representatives of Pennsyluania, having been elected from the city of Philadelphia, as one of the five members chosen to represent the old city proper, on a general ticket. The railroad bills in which the city was interested were placed in my hands. A supplement to the Charter of the Pennsylvania Railroad Company was obtained, which conferred many valuable privileges. It provided a more just and equitable mode of assessing land damages; it confirmed the city subscription to the stock; it authorized the county of Allegheny to subscribe for stock to the amount of a million dollars, which was afterwards done; and it authorized the connection with the Portage Railroad. It also made some reduction in the tonnage tax. Legislation was obtained in another bill for the survey of a line to avoid the inclined plane near Philadelphia.

At the same session a charter was obtained for a railroad from Pittsburgh westward, on the line towards Fort Wayne and Chicago. I was afterwards the chief engineer of it, from Pittsburgh to Crestline, a distance of 188 miles. I had charge of the location, construction, and working of the road as far west as Crestline, from 1848 to 1856, and the towns of Alliance and Crestline were located, and their names selected by me. This line was originally called the Ohio and Pennsylvania Railroad, as it was chartered by both of those States, and was the first line to connect their railroad systems. It has become a most important feeder to the Pennsylvania Railroad. On the 6th of January, 1852, the road was opened from Pittsburgh to Alliance, 82 miles, where it connected with a railroad to Cleveland; and, very shortly after, I took Louis Kossuth and his party of Hungarians over it, which was the occasion of a great ovation. The road was opened to Crestline on the 11th of April, 1853, where it connected with a direct railroad to Columbus and Cincinnati. This road thus opened has now been in use for about twenty-five years, and has been of great public utility.

The completion of the line between Crestline and Chicago was delayed by financial difficulties for some years, but it was opened throughout in December, 1858, mainly by the efforts of John Edgar Thomson.

The competition which was for some time carried on between the Pennsylvania Railroad and the main line, owned by the State, was found to be injurious to both; and, after protracted negotiations, the State sold its line to the company. On the 20th of July, 1857, a meeting of the stockholders of the Pennsylvania Railroad Company was held at Sansom-street Hall, to act upon the purchase of the main line, of canals, and railroads between Philadelphia and Pittsburgh. Having been selected for the purpose, I offered the resolutions, and spoke in their favor. The measure was adopted with but little opposition, and, on the first of the following month, August 1st, 1857, the Governor, by proclamation, transferred the main line to the railroad company. The Pennsylvania Railroad Co. thus became the owner of the Portage Railroad, and, as it was not the interest of the company to keep it up and work it, it soon went out of use. It had had its day, and something better had taken its place; and, instead of lasting for many generations, the time of its existence was but about twenty-five years.

The great improvements made in locomotive engines have enabled them to work to advantage on steep grades, so as to supersede stationary power, and to draw long and heavy trains continuously for many miles, without stopping for any change. Railroad tracks have also been greatly improved. The foundations are better; the rails are longer and stronger; the joints are fewer and much safer, and the switches and signals are much better than they were. Steel rails, and steel tires on locomotive driving-wheels, have come into extensive use, and add much to the durability and safety of the roads. Switch rails were at first of cast iron; and, afterwards, of rolled iron, with a pivot, or hinge, welded on at the heel of the switch. On the Portage Railroad I introduced the plan of holding the switch-rail fast in a chair, and bending the rail by the switch lever, as is now done in the common stub switch. Improved safety switches have since been invented, and are now extensively used.

When I went to the iron works in Wales, in 1836, the rails were allowed to get cold after coming from the rolls, and the ends were afterwards reheated, and the fag ends cut off by hand. While I was there the circular saws were brought into use, by which the ends of the rails are now cut off when hot from the rolls. The iron rails made under my direction, at the Ebbw Vale Iron Works, for the Reading Railroad, were unusually good for that time; but good steel rails, of American manufacture, can now be bought for less than those cost in Wales.

Fifty years have passed since I rode on the Mauch Chunk Railroad, on the first train of cars that ever ran in Pennsylvania, and, during that long period, my interest in the growth of our railroad system has never ceased. Four years later, when I led the locating party on the Allegheny Portage Railroad, it was with a feeling of enthusiasm for my professional employment which it gives me pleasure to recall. To be useful to my native State and city, and to help to promote the prosperity of Pennsylvania, were my lively hope and strong desire, for it is a State of which we may well be proud. The strong foundations of her history were laid by William Penn, in principles of truth and justice which must endure forever. Although the railroad of which I have spoken has ceased to exist, yet I need not say,

> "So fades, so perishes, grows dim, and dies,
> All that this world is proud of."

Or, "What profit hath a man of all his labor, which he taketh under the sun?"

The present is the child of the past, and will be the parent of the future, and to keep the past from being forgotten, and to preserve its lessons for our instruction, is the highly useful office of the Historical Society of Pennsylvania, which I trust it